A.O.Smith Water Heaters

COPPER BOILERS FOR HYDRONIC HEATING AND HOT WATER SUPPLY

- Installation
- Operation
- Maintenance
- Limited Warranty

Burkay GENESIS
A.O. Smith Space Saver Gas Boiler

Instruction Manual

GB/GW MODELS:

1000, 1300, 1500, 1850, 2100, 2500

SERIES: 400, 401, 402, 403, 404, 405

FM APPROVED

CAUTION

TEXT PRINTED OR OUTLINED IN RED CONTAINS INFORMATION RELATIVE TO YOUR SAFETY. PLEASE READ THOROUGHLY BEFORE INSTALLING AND USING THIS APPLIANCE.

WARNING: If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

- Extinguish any open flame.
- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

- Installation and service must be performed by a qualified installer, service agency or the gas supplier.

PLACE THESE INSTRUCTIONS ADJACENT TO BOILER AND NOTIFY OWNER TO KEEP FOR FUTURE REFERENCE.

PRINTED IN U.S.A. 0906

Thank You

for buying this cost efficient, high recovery unit from A. O. Smith Water Products Co.

You should thoroughly read and understand this manual before installation and/or operation of this boiler. Please pay particular attention to the important safety and operating instructions as well as the WARNINGS and CAUTIONS.

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DIMENSIONS/CAPACITIES DATA

IMPORTANT!
Refer to "Installation Clearances" section of manual (page 7) for recommended service clearances prior to boiler placement.

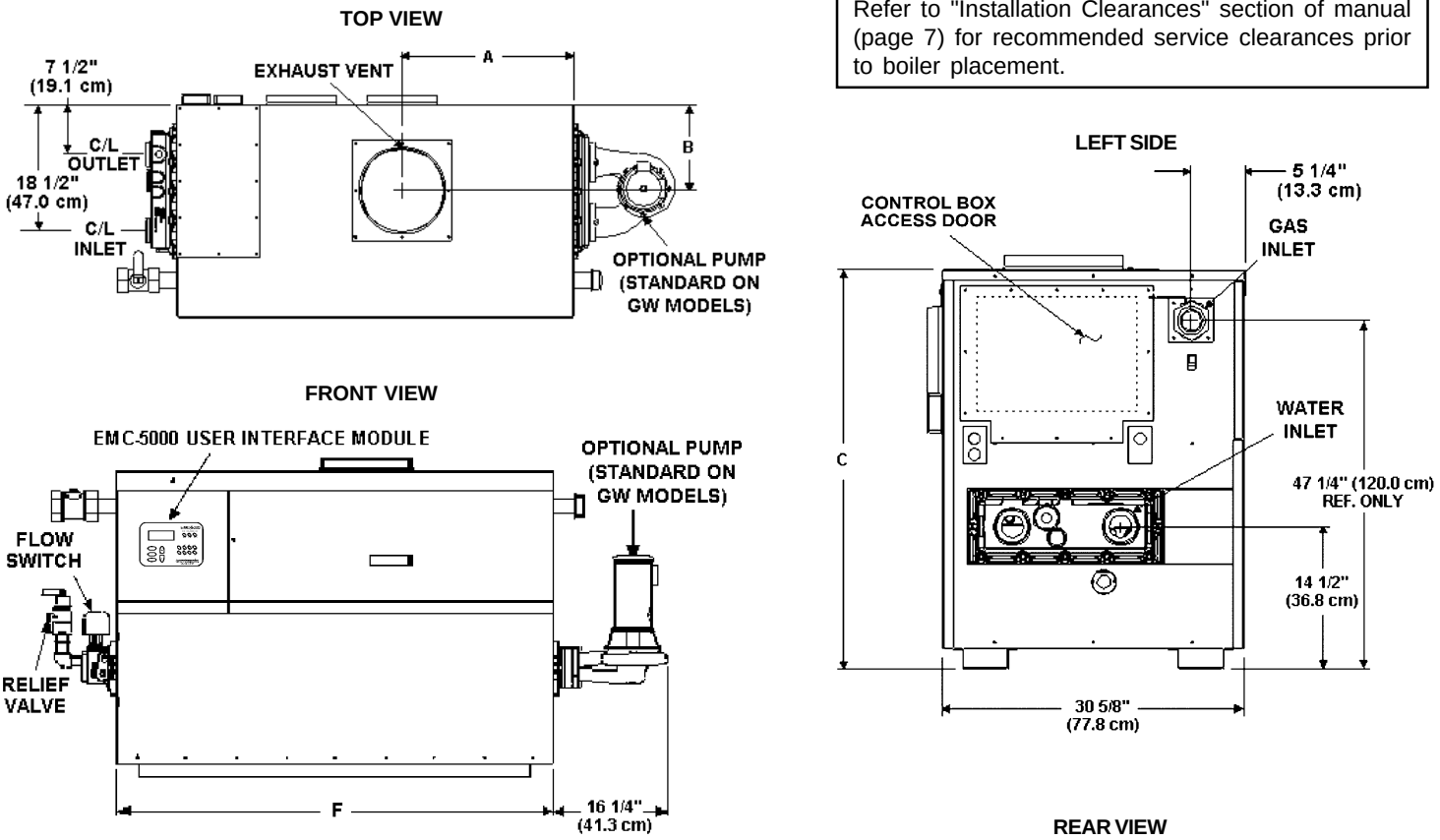

Figure 1.

TABLE 1: GAS AND ELECTRICAL REQUIREMENT

MODEL	Manifold Pressure			Electrical Characteristics	
	Type of Gas	Inches W.C.	kPa	Volts/Hz	Amperes
GW/GB-1000 thru 2500	NATURAL	3.5	0.87	120/60	30
GW/GB-1000 thru 2500	PROPANE	10	2.49	120/60	30

All Models - Maximum Supply Pressure: 14.0 In. W.C. (3.49 kPa)
Minimum Supply Pressure Natural Gas: 6.0 In. W.C. (1.22 kPa)
Minimum Supply Pressure Propane Gas: 11.0 In. W.C. (2.74 kPa)
Minimum Pressures must be maintained during operating conditions.

TABLE 2. DIMENSIONAL DATA

Model	A		B		C		D		E		F	
	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm
GW/GB-1000	14.1	35.8	12.2	31.0	40.3	102.4	31.6	80.3	26.0	66.0	46.8	118.9
GW/GB-1300	24.8	63.0	12.2	31.0	40.3	102.4	31.6	80.3	39.3	99.8	57.3	145.5
GW/GB-1500	30.2	76.7	12.2	31.0	40.3	102.4	31.6	80.3	44.6	113.3	64.3	163.3
GW/GB-1850	27.7	70.4	11.2	28.4	43.0	109.2	32.3	82.0	44.0	111.8	78.3	198.9
GW/GB-2100	31.0	78.7	11.2	28.4	43.0	109.2	32.3	82.0	49.5	125.7	85.3	216.7
GW/GB-2500	38.1	96.8	10.5	26.7	43.0	109.2	32.3	82.0	56.5	143.5	99.3	252.2

Model	Input Rating				Exhaust Vent Diameter		Air Intake Diameter		Water Conn. Size	Gas Inlet
	BTU/Hr. Natural Gas	KW Natural Gas	BTU/Hr. Propane Gas	KW Propane Gas	Inches	cm	Inches	cm		
GW/GB-1000	990,000	289.95	990,000	289.95	10	25.4	8	20.3	2 1/2 NPT	2 NPT
GW/GB-1300	1,300,000	380.74	1,300,000	380.74	12	30.5	10	25.4	2 1/2 NPT	2 NPT
GW/GB-1500	1,500,000	439.31	1,500,000	439.31	12	30.5	10	25.4	2 1/2 NPT	2 NPT
GW/GB-1850	1,850,000	541.82	1,850,000	541.82	14	35.6	10	25.4	2 1/2 NPT	2 1/2 NPT
GW/GB-2100	2,100,000	615.04	2,100,000	615.04	14	35.6	12	30.5	2 1/2 NPT	2 1/2 NPT
GW/GB-2500	2,490,000	729.26	2,490,000	729.26	16	40.7	12	30.5	2 1/2 NPT	2 1/2 NPT

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DIMENSIONS DATA FOR OUTDOOR CONFIGURATION

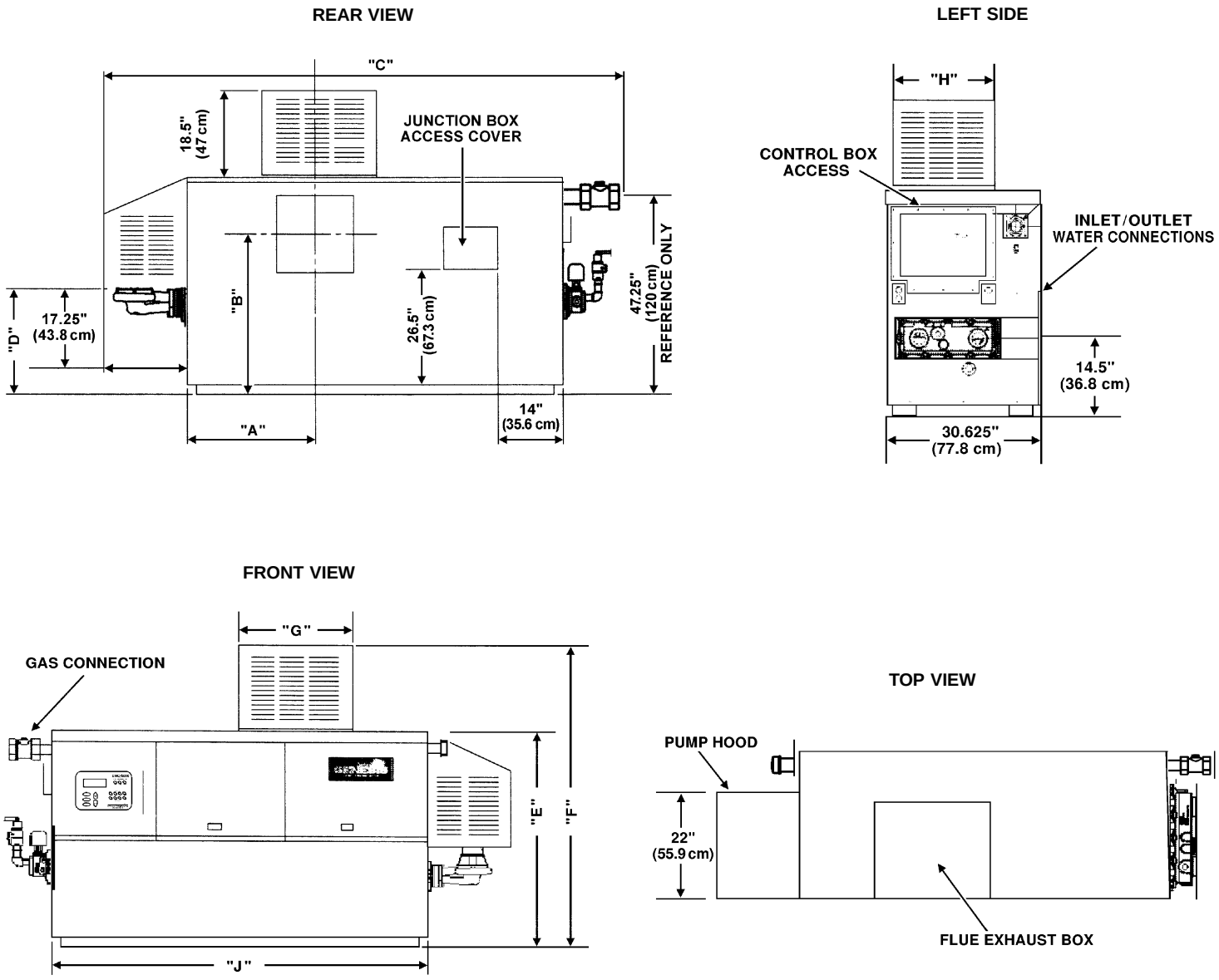

Figure 2.

TABLE 3. DIMENSIONAL DATA

	A		B		C		D		E		F		G		H		J	
Model	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm
GBO/GWO-1000	14	35.5	31.6	80.3	71.8	182.4	15.5	39.4	39.75	101	58.25	148	15.9	40.83	16	40.64	46.8	118.9
GBO/GWO-1300	24.75	62.9	31.6	80.3	82	208.3	15.5	39.4	39.75	101	58.25	148	15.9	40.83	16	40.64	57.3	145.5
GBO/GWO-1500	30	76.2	31.6	80.3	89	226	15.5	39.4	39.75	101	58.25	148	15.9	40.83	16	40.64	64.3	163.3
GBO/GWO-1850	27.5	69.9	32.3	82	103	261.6	18.9	48	43	109.2	61.5	156.2	23.9	60.7	20	50.8	78.3	198.9
GBO/GWO-2100	31	78.7	32.3	82	110	279.4	18.9	48	43	109.2	61.5	156.2	23.9	60.7	20	50.8	85.3	216.7
GBO/GWO-2500	38	96.5	32.3	82	124	315	18.9	48	43	109.2	61.5	156.2	23.9	60.7	20	50.8	99.3	252.2

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TABLE 4: RECOVERY CAPACITIES

MODEL	Input Rating BTU/Hr. (kW)	Water Flow	TEMPERATURE RISE - DEGREES °F (°C)									
			40°F (22.2°)	50°F (27.7°)	60°F (33.3°)	70°F (38.8°)	80°F (44.4°)	90°F (50°)	100°F (55.5°)	110°F (61.1°)	120°F (66.7°)	130°F (72.2°)
GW - 1000	990,000 (290.1)	GPH	2520	2016	1680	1440	1260	1120	1008	916	840	775
		LPH	9526	7620	6350	5443	4763	4234	3810	3462	3175	2930
GW - 1300	1,300,000 (380.9)	GPH	3309	2647	2206	1891	1655	1471	1324	1203	1103	1018
		LPH	12508	10006	8339	7148	6256	5560	5005	4547	4169	3848
GW - 1500	1,500,000 (439.5)	GPH	3818	3055	2545	2182	1909	1697	1527	1388	1273	1175
		LPH	14432	11548	9620	8248	7216	6415	5772	5247	4812	4442
GW - 1850	1,850,000 (542.0)	GPH	4709	3767	3139	2691	2355	2093	1884	1712	1570	1449
		LPH	17800	14239	11865	10172	8902	7912	7122	6471	5935	5477
GW - 2100	2,100,000 (615.3)	GPH	5345	4276	3564	3055	2673	2376	2138	1944	1782	1645
		LPH	20204	16163	13472	11548	10104	8981	8082	7348	6736	6218
GW - 2500	2,490,000 (729.6)	GPH	6338	5071	4225	3622	3169	2817	2535	2305	2113	1950
		LPH	23958	19168	15971	13691	11979	10648	9582	8713	7987	7371

TABLE 5: PUMPING PERFORMANCE GUIDE

MODEL	GB MODELS-FLOW, HEAD LOSS AND TEMPERATURE RISE											
	20 Deg. F Rise		30 Deg. F Rise		40 Deg. F Rise		Maximum Flow Rate			Minimum Flow Rate		
	GPM	PD-FT Head	GPM	PD-FT Head	GPM	PD-FT Head	GPM	PD-FT Head	Deg. F Rise	GPM	PD-FT Head	Deg. F Rise
GB - 1000	83	5.1	55	2.7	41.6	1.5	154	12.2	11	42	1.5	40
GB - 1300	109	7.2	72.8	4.2	54.6	3.2	154	14.5	14	55	3.2	40
GB - 1500	126	10.1	84	6.3	63	4.3	154	16.3	17	64	4.3	40
GB - 1850	154	18.5	103.6	10.1	77.7	6.4	154	18.5	20	78	6.4	40
GB - 2100	n/a	n/a	117.6	14.5	88	8.3	154	21.3	23	89	8.3	40
GB - 2500	n/a	n/a	139.4	18.5	104.6	11.6	154	23.2	28	105	11.6	40

Note: GW models (GB optional) are equipped with pumps capable of handling 50 equivalent feet (15.2 m) of normal pipe fittings.

FOREWORD

Detailed installation diagrams are in this manual. These diagrams will provide the installer with a reference of materials needed and a suggested method of piping. IT IS NECESSARY THAT ALL WATER AND GAS PIPING, AND THE ELECTRICAL WIRING BE INSTALLED AND CONNECTED AS SHOWN IN THE DIAGRAMS.

CHECK DIAGRAMS THOROUGHLY BEFORE STARTING INSTALLATION TO AVOID POSSIBLE ERRORS AND MINIMIZE TIME AND MATERIALS COST. SEE FIGURES 1 THROUGH 5 AND TABLES 1, 2, AND 3.

This design complies with the current edition of ANSI Z21.13-CSA 4.9 for Gas-Fired Low-Pressure Steam and Hot Water Boilers.

MAKE SURE THE GAS ON WHICH THE BOILER WILL OPERATE IS THE SAME AS THAT SPECIFIED ON THE BOILER RATING PLATE.

The boiler installation must conform to these instructions and the local code authority having jurisdiction. In the absence of local codes, the installation must comply with the latest editions of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and the National Electrical Code, NFPA 70 or CAN/CSA B149.1, and CSA 2 C22.1. The former is available from the Canadian Standards Association, 8501 East Pleasant Valley Road, Cleveland, OH 44131, and both documents are available from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269.

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GROUNDING INSTRUCTIONS

This boiler must be grounded in accordance with the National Electrical Code, NFPA 70 or the Canadian Electrical Code CSA 2 C22.1 and/or local codes. The boiler is polarity sensitive, correct wiring is imperative for proper operation.

This boiler must be connected to a grounded metal, permanent wiring system, or an equipment grounding conductor must be run with the circuit conductors and connected to the equipment grounding terminal or lead on the boiler.

WARNING

YOUR BOILER IS NOT DESIGNED TO OPERATE WITH A BOILER INLET WATER TEMPERATURE OF LESS THAN 120°F (49°C). COLDER INLET WATER TEMPERATURE WILL RESULT IN SIGNIFICANT CONDENSATION DEVELOPING ON THE HEAT EXCHANGER. THIS SITUATION CAN CAUSE A CORROSIVE ENVIRONMENT FOR THE HEAT EXCHANGER, BURNERS AND VENTING RESULTING IN PREMATURE DAMAGE, WHICH COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

FOR SYSTEMS THAT USE LARGE VOLUMES OF COLD WATER OR SYSTEMS UTILIZING HEAVY WATER DRAWS, CONDENSATION CAN BE PREVENTED BY USING A BYPASS LOOP.

CORRECT GAS

Make sure the gas on which the boiler will operate is the same as that specified on the boiler rating plate. Do not install the boiler if equipped for a different type of gas, consult your gas supplier.

PRECAUTIONS

IF THE UNIT IS EXPOSED TO THE FOLLOWING, DO NOT OPERATE UNTIL ALL CORRECTIVE STEPS HAVE BEEN MADE BY A QUALIFIED SERVICEMAN:

1. EXPOSURE TO FIRE.
2. IF DAMAGED.
3. FIRING WITHOUT WATER.
4. SOOTING.

IF THE BOILER HAS BEEN EXPOSED TO FLOODING, IT MUST BE REPLACED.

LIQUID PETROLEUM MODELS

Boilers for propane or liquefied petroleum gas (LPG) are different from natural gas models. A natural gas boiler will not function safely on LP gas and no attempt should be made to convert a boiler from natural gas to LP gas.

LP gas must be used with great caution. It is highly explosive and heavier than air. It collects first in the low areas making its odor difficult to detect at nose level. If LP gas is present or even suspected, do not attempt to find the cause yourself. Leave the building, leaving doors open to ventilate, then call your gas supplier or service agent. Keep area clear until a service call has been made.

At times you may not be able to smell an LP gas leak. One cause is odor fade, which is a loss of the chemical odorant that gives LP gas its distinctive smell. Another cause can be your physical condition, such as having a cold or diminishing sense of smell with age. For these reasons, the use of a propane gas detector is recommended. IF YOU EXPERIENCE AN OUT OF GAS SITUATION, DO NOT TRY TO RELIGHT APPLIANCES YOURSELF. Call your local service agent. Only trained LP professionals should conduct the required safety checks in accordance with industry standards.

HIGH ALTITUDE INSTALLATION

WARNING

INSTALLATIONS ABOVE 4,500 FEET REQUIRE REPLACEMENT OF THE BURNER ORIFICES. FAILURE TO REPLACE THE ORIFICES WILL RESULT IN IMPROPER AND INEFFICIENT OPERATION OF THE APPLIANCE, PRODUCING CARBON MONOXIDE GAS IN EXCESS OF SAFE LIMITS, WHICH COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

GENESIS BOILERS ARE EQUIPPED WITH SELF-REGULATING PREJET ORIFICES WHICH AUTOMATICALLY COMPENSATE FOR HIGHER ELEVATIONS AND ADJUST THE APPLIANCE'S INPUT RATE ACCORDINGLY, MAKING IT UNNECESSARY TO REPLACE ORIFICES FOR HIGH ALTITUDE (UP TO 4,500 FEET). CONSULT THE FACTORY FOR HIGHER ALTITUDES.

Some utility companies derate their gas for altitude. You should contact your gas supplier for any specific changes which may be required in your area. Call the local gas utility to verify BTU content of the gas supplied.

Input rating specified on the rating plate applies to elevations up to 4,500 feet (1350 m). For elevations above 4,500 feet (1350 m), ratings must be reduced, consult the factory.

FEATURES/CONTROLS

MULTI-STAGE FIRING AND CONTROL SYSTEM

ALL MODELS - The control system consists of four basic components: 1) Central Control Board 2) Flame Control Board 3) User Interface Module 4) Power Distribution Board; see Figures 17, 18, 19 and 21. The Central Control Board, Flame Control Boards and the Power Distribution Board are located in the control box and can be accessed through panels on the left side and top of the unit. The User Interface Module is attached to the front jacket panel. The control system is a multi-stage control capable of managing three or four firing stages. Models 1000, 1300, and 1500 operates with 3-stage fire. Models 1850, 2100 and 2500 operates with 4-stage fire. Every system will have one Central Control Board (CCB), one Power Distribution Board (PDB), one User Interface Module (UIM) and either two or three Flame Control Boards (FCB) depending on the model.

The Control Boards Figure 17 and 18, contain dipswitches which allow the user to control several system options. See Control System Section.

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DIFFERENTIAL PRESSURE SWITCH

The differential pressure switch ensures that a sufficient differential exists between the air pressure in the pre-mix chamber and the inlet of the burner for safe, combustion and proper low NO_X emission. The switch has two pressure taps marked "+" (positive) and "-" (negative). Silicone tubing is run from the positive pressure tap of the switch to a tap on the control panel to measure the air pressure in the pre-mix chamber. The negative pressure tap measures the pressure taken at the burner's auxiliary tube. Connections can be seen by removing the lower front jacket panel. It is important that this panel remain sealed at all times while the boiler is operating.

The differential pressure switch is normally open and closes when the combustion blower starts.

BLOCKED FLUE PRESSURE SWITCH

The blocked flue pressure switch ensures that the vent system is clear. This pressure switch is normally closed and only opens on fault conditions.

FLAME SENSOR

The flame sensor detects the flame presence on burner's ports. If no flame is sensed, the gas valve(s) will close automatically. If no flame is sensed on three ignition trials the boiler will lock out. In the event of a lockout, depress the SELECT button on the UIM to restart the boiler.

WATER FLOW SWITCH

The water flow switch is installed at the boiler outlet to prevent burner operation in the event of inadequate water flow through the boiler. It is a normally open switch that will close its contacts when increasing water flow rate is detected. The water flow switch is factory-set, but may require field adjustment. The contacts will open when the flow rate drops below the adjusted setting causing the gas valve(s) to close which will turn off the gas to the burners.

LIMIT CONTROLS

⚠ CAUTION

LIMIT CONTROLS ARE SAFETY DEVICES AND ARE NOT TO BE USED AS AN OPERATING CONTROL (THERMOSTAT).

The "G(B/W)" models incorporate an outlet water probe consisting of two limit controls:

1. An adjustable automatic reset limit control, that can be set as high as either 210°F (99°C) or 235°F (113°C) depending on the application.

2. A fixed manual reset limit (ECO) factory set at 244°F (118°C). If the manual reset should open due to high temperature, the gas valves will close and the unit will go into lockout. If lockout occurs, push the SELECTION button on the UIM to restart the boiler.

ON/OFF SWITCH

The ON/OFF switch is a single-pole, single-throw rocker switch. The switch provides 120VAC from the line source to the boiler.

COMBUSTION AIR BLOWER

Provides air for combustion process. The blower settings are adjustable through the use of the air shutter, however, blowers are set at the factory and might require slight adjustment depending on site installation.

TANK PROBE

FOR HOT WATER SUPPLY SYSTEMS (GW models), a tank probe is supplied with each hot water supply boiler.

Note: The tank probe must be designated as the controlling probe using dip switch "4" on Central Control Board (Figure 17) before it can be used for (GW) hot water supply applications.

"Pigtails" of field-supplied wires should be spliced to "pigtails" of tank probe and connected to terminal block in the 24VAC junction box. See Figure 12 for the tank probe installation. Follow the instructions in the "TANK PROBE INSTALLATION PROCEDURE". See page 18.

FOR HOT WATER HEATING SYSTEMS (GB models), a tank probe is not supplied with the GB models due to the many various types of systems and operating conditions. A tank probe can be used as an option to control loop temperature and unit staging. Additionally, the inlet temperature probe can be used as the loop thermostat in some heating applications. The tank probe connects to designated wires in the junction box at the rear of the boiler. **Do not operate this boiler using the internal high limits only, use a tank probe or operating thermostat to control system temperatures.**

Note: The tank probe or additional 24VAC devices must be identified using Dipswitches on Central Control Board before they are recognized as a part of the heating system; see Table 5. Refer to "Control System" section for more information about dipswitch settings.

CIRCULATING PUMP

The pump flow rate should not exceed the maximum recommended flow rate; see Table 5.

FOR HOT WATER SUPPLY SYSTEMS (GW models), ordered with the circulator as an integral part of the boiler; the pump has been lubricated at the factory, and future lubrication should be in accordance with the motor manufacturer's instructions provided as supplement to this manual.

FOR HOT WATER HEATING SYSTEMS (GB models or GW models ordered without circulator), the circulator is NOT provided and must be field-installed.

LOW WATER CUTOFF (Not Supplied)

If low water level protection is required by the authorities having jurisdiction, a low water cutoff switch should be installed next to the boiler in the outlet water line as shown in "HYDRONIC INSTALLATION" section; see page 16. The switch should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months.

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DRAIN VALVE (Not Supplied)

Additional drain valves must be obtained and installed on each boiler and tank for draining purposes.

SAFETY RELIEF VALVES

Your local code authority may have other specific relief valve requirements not covered below.

⚠ WARNING

THE PURPOSE OF A SAFETY RELIEF VALVE IS TO AVOID EXCESSIVE PRESSURE WHICH MAY CAUSE TANK EXPLOSION, SYSTEM OR BOILER DAMAGE.

TO AVOID WATER DAMAGE A DRAIN LINE MUST BE CONNECTED TO A SAFETY RELIEF VALVE FOR DIRECT DISCHARGE TO A SAFE LOCATION. A DRAIN LINE MUST NOT BE REDUCED FROM THE SIZE OF THE VALVE OUTLET AND IT MUST NOT CONTAIN ANY VALVES BETWEEN THE BOILER AND THE RELIEF VALVE OR THE RELIEF VALVE AND THE DRAIN EXIT. IN ADDITION, THERE SHOULD NOT BE ANY RESTRICTIONS IN A DRAIN LINE NOR SHOULD IT BE ROUTED THROUGH AREAS WHERE FREEZING CONDITIONS MIGHT OCCUR. DO NOT THREAD OR CAP THE DRAIN LINE EXIT. RESTRICTING OR BLOCKING A DRAIN LINE WILL DEFEAT THE PURPOSE OF THE RELIEF VALVE AND MAY CREATE AN UNSAFE CONDITION. INSTALL A DRAIN LINE WITH A DOWNWARD SLOPE SUCH THAT IT NATURALLY DRAINS ITSELF.

If any safety relief valve is replaced, the replacement valve must comply with the latest version of the ASME Boiler and Pressure Vessel Code, Section IV (HEATING BOILERS). Select a relief valve with a discharge rating NOT less than the boiler input, and a set pressure NOT exceeding the working pressure of any component in the system.

The storage tank temperature and pressure relief valve must comply with the applicable construction provisions of the Standard for Relief Valves for Hot Water Supply Systems, ANSI Z21.22-CSA-4.4 (current edition). The valve must be of the automatic reset type and not embody a single-use type fusible plug, cartridge or linkage.

FOR HOT WATER HEATING SYSTEMS, the boilers are shipped with a 50 psi pressure relief valve. This relief valve is factory installed on the water outlet header of the boiler.

FOR HOT WATER SUPPLY SYSTEMS, the boilers are shipped with a 125 psi pressure relief valve. This relief valve is factory installed on the water outlet header of the boiler. This ASME-rated valve has a discharge capacity that exceeds the maximum boiler input rating and a pressure rating that does not exceed the maximum working pressure shown on the boiler rating plate.

In addition, a CSA design-certified and ASME-rated temperature and pressure (T & P) relief valve must be installed on every water storage tank in the hot water supply system; see Figures 11 and 13.

The T & P relief valve should have a temperature rating of 210°F (99°C), a pressure rating NOT exceeding the lowest rated working pressure of any system component, and a discharge capacity exceeding the total input of the water boilers supplying water to the storage tank.
Locate the T & P relief valve (a) in the top of the tank, or (b) in the side of the tank on a center line within the upper six (6) inches (15 cm) of the top of the tank. The tapping shall be threaded in accordance with the latest edition of the Standard for Pipe Threads, General Purpose (inch), ANSI/ASME B1.20.1. The location of, or intended location for, the T & P relief valve shall be readily accessible for servicing or replacement.

INSTALLATION INSTRUCTIONS

REQUIRED ABILITY

INSTALLATION OR SERVICE OF THIS BOILER REQUIRES ABILITY EQUIVALENT TO THAT OF A LICENSED TRADESMAN IN THE FIELD INVOLVED. PLUMBING, AIR SUPPLY, VENTING, GAS SUPPLY AND ELECTRICAL WORK ARE REQUIRED.

LOCATION

When installing the boiler, consideration must be given to proper location. The location selected should be as close to the stack or chimney as practical with adequate air supply and as centralized with the piping system as possible. The location should also be such that the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)

- THE BOILER MUST NOT BE INSTALLED ON CARPETING.
- THE BOILER SHOULD NOT BE LOCATED IN AN AREA WHERE IT WILL BE SUBJECT TO FREEZING.
- THE BOILER SHOULD BE LOCATED NEAR A FLOOR DRAIN.
- THE BOILER SHOULD BE LOCATED IN AN AREA WHERE LEAKAGE FROM THE BOILER OR CONNECTIONS WILL NOT RESULT IN DAMAGE TO THE ADJACENT AREA OR TO LOWER FLOORS OF THE STRUCTURE.

WHEN SUCH LOCATIONS CANNOT BE AVOIDED, A SUITABLE DRAIN PAN SHOULD BE INSTALLED UNDER THE BOILER. Such pans should be fabricated with sides at least 2-1/2" (6.5 cm) deep, with length and width at least 2" (5.1 cm) greater than the dimensions of the boiler and must be piped to an adequate drain. The pan must not restrict combustion air flow.

⚠ WARNING

THERE IS A RISK IN USING FUEL BURNING APPLIANCES IN ROOMS OR AREAS WHERE GASOLINE, OTHER FLAMMABLE LIQUIDS OR ENGINE DRIVEN EQUIPMENT OR VEHICLES ARE STORED, OPERATED OR REPAIRED. FLAMMABLE VAPORS ARE HEAVY AND TRAVEL ALONG THE FLOOR AND MAY BE IGNITED BY THE IGNITER OR MAIN BURNER FLAMES CAUSING FIRE OR EXPLOSION. SOME LOCAL CODES PERMIT OPERATION OF GAS APPLIANCES IF INSTALLED 18 INCHES (46.0 CM) OR MORE ABOVE THE FLOOR. THIS MAY REDUCE THE RISK IF LOCATION IN SUCH AN AREA CANNOT BE AVOIDED.

FLAMMABLE ITEMS, PRESSURIZED CONTAINERS OR ANY OTHER POTENTIAL FIRE HAZARDOUS ARTICLES MUST NEVER BE PLACED ON OR ADJACENT TO THE BOILER.

OPEN CONTAINERS OF FLAMMABLE MATERIAL SHOULD NOT BE STORED OR USED IN THE SAME ROOM WITH THE BOILER.
A hot water boiler installed above radiation level or as required by

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the authority having jurisdiction, must be provided with a low water cutoff device either as a part of the boiler or at the time of boiler installation.

⚠ WARNING

UNDER NO CIRCUMSTANCES SHOULD THE EQUIPMENT ROOM WHERE THE BOILER IS INSTALLED EVER BE UNDER NEGATIVE PRESSURE. PARTICULAR CARE MUST BE TAKEN WHEN EXHAUST FANS, COMPRESSORS, AIR HANDLING EQUIPMENT, ETC., MAY INTERFERE WITH THE COMBUSTION AND VENTILATION AIR SUPPLIES OF THIS BOILER.

CHEMICAL VAPOR CORROSION

Heat exchanger corrosion and component failure can be caused by the heating and breakdown of airborne chemical vapors. Spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes, and process chemicals are typical compounds which are corrosive. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence.

Products of this sort should not be stored near the boiler. Also, air which is brought in contact with the boiler should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outside sources. **Failure to observe this requirement will void the warranty.**

INSTALLATION CLEARANCES

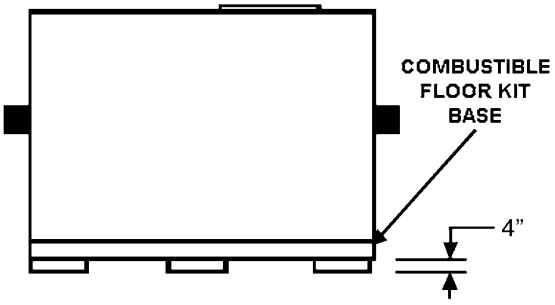
Sufficient area should be provided at the front and sides of the unit for proper servicing. For ease of service, minimum clearances of 24" (61.0 cm) in the front and 18" (46.0 cm) on the sides are recommended. It is important that the minimum clearances be observed to allow service to the control box and other controls. Observing proper clearances will allow service to be performed without movement or removal of the boiler from its installed location. Failure to observe minimum clearances may require removal of the boiler in order to service such items as the heat exchanger and burners. In a utility room installation, the door shall be wide enough to allow the boiler to enter or to permit the replacement of another appliance.

Two inch (5.1 cm) clearance is allowable from combustible construction to hot water pipes. Sufficient clearance should be provided at one end of the boiler to permit access to heat exchanger tubes for cleaning.

Access to control box items such as the Central Control Board, Flame Control Boards, Power Distribution Board and wiring harnesses is provided through a panel on the left side of the unit. A minimum service clearance of 18" (46.0 cm) is required.

These boilers are approved for installation on noncombustible flooring in an alcove with minimum clearance to combustibles of: 3 inches (7.6 cm) Right Side, and Back; 6 inches (15.2 cm) Top; Front, Alcove; 12 inches (30.5 cm) Left Side; and 6 inches (15.2 cm) surrounding the Vent.

For installation on combustible flooring use the Combustible Floor Kit. The combustible floor kit base adds 4" (10.1 cm) to the overall height of the boiler. See Figure 3.



MODEL	COMBUSTIBLE BASE KIT NUMBER
G(B,W) - 1000	211093
G(B,W) - 1300	211093-1
G(B,W) - 1500	211093-2
G(B,W) - 1850	211093-3
G(B,W) - 2100	211093-4
G(B,W) - 2500	211093-5

Figure 3. Boiler on Combustible Floor Base and Kit Numbers.

LEVELLING

Each unit must be checked after installation to be certain that it is level.

AIR REQUIREMENTS

⚠ WARNING

FOR SAFE OPERATION, AN AMPLE SUPPLY OF AIR MUST BE PROVIDED FOR PROPER COMBUSTION AND VENTILATION IN ACCORDANCE WITH THE NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA-B149.1 CURRENT EDITION OR APPLICABLE PROVISIONS OF THE LOCAL BUILDING CODES. AN INSUFFICIENT SUPPLY OF AIR MAY RESULT IN A YELLOW, LUMINOUS BURNER FLAME, CARBONING OR SOOTING OF THE FINNED HEAT EXCHANGER, OR CREATE A RISK OF ASPHYXIATION. DO NOT OBSTRUCT THE FLOW OF COMBUSTION AND VENTILATION AIR.

UNCONFINED SPACE

In buildings of conventional frame, brick or stone construction, unconfined spaces may provide adequate air for combustion.

If the unconfined space is within a building of tight construction (buildings using the following construction: weather stripping, heavy insulation, caulking, vapor barrier, etc.), air for combustion, ventilation, must be obtained from outdoors or spaces freely communicating with the outdoors. The installation instructions for confined spaces in tightly constructed buildings must be followed to ensure adequate air supply.

CONFINED SPACE

(a) U. S. INSTALLATIONS

When drawing combustion and dilution air from inside a conventionally constructed building to a confined space, such a space shall be provided with two permanent openings, ONE WITHIN 12 INCHES OF THE ENCLOSURE TOP AND ONE WITHIN 12 INCHES OF THE ENCLOSURE BOTTOM. Each opening shall have a free area of at least one square inch per 1000 Btu/hr (22 cm^2/k W) of the total input of all appliances in the enclosure.

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If the confined space is within a building of tight construction, air for combustion, ventilation, and draft hood dilution must be obtained from outdoors. When directly communicating with the outdoors or communicating with the outdoors through vertical ducts, two permanent openings, located in the above manner, shall be provided. Each opening shall have a free area of not less than one square inch per 4000 Btuh (5.5 cm^2/kW) of the total input of all appliances in the enclosure. If horizontal ducts are used, each opening shall have a free area of not less than one square inch per 2000 Btuh (11 cm^2/kW) of the total input of all appliances in the enclosure.

(b) CANADIAN INSTALLATIONS

Ventilation of the space occupied by the boiler(s) shall be provided by an opening for ventilation air at the highest practical point communicating with outdoors. The total cross-sectional area shall be at least 10% of the area of the combustion air opening but in no case shall the cross-sectional area be less than 10 square inches (64.5 cm^2).

In addition to the above, there shall be permanent air supply opening(s) having a cross-sectional area of not less than 1 square inch per 7,000 BTUH (3.2 cm^2/kW) up to and including 1,000,000 BTUH plus 1 square inch per 14,000 BTU (1.6 cm^2/kW) in excess of 1,000,000 BTUH. This opening(s) shall be located at, or ducted to, a point neither more than 18" (46.0 cm) nor less than 6 inches (15.2 cm) above the floor level.

Where power vented equipment is used in the same room as the boiler, sufficient air openings must be supplied. UNDERSIZED OPENINGS MAY RESULT IN INSUFFICIENT AIR FOR COMBUSTION.

Where an exhaust fan is installed in the same room with a boiler, sufficient openings for air must be provided in the walls. UNDERSIZED OPENINGS WILL CAUSE AIR TO BE DRAWN INTO THE ROOM THROUGH THE CHIMNEY, CAUSING POOR COMBUSTION. SOOTING MAY RESULT WITH AN INCREASED RISK OF ASPHYXIATION.

VENTING

⚠ CAUTION

WHEN VENTING THE GENESIS BOILER THROUGH AN OVERSIZED CHIMNEY (INCLUDING MASONRY CHIMNEYS), ADDITIONAL CARE MUST BE EXERCISED TO ASSURE PROPER DRAFT. FOR PROPER OPERATION, **A MINIMUM DRAFT OF -0.02" W.C. AND A MAXIMUM DRAFT OF -0.04" W.C. MUST BE MAINTAINED. IN INSTANCES OF EXCESSIVE DRAFT, A BAROMETRIC DAMPER MAY BE REQUIRED TO ASSIST IN MAINTAINING THE PROPER DRAFT.** DRAFT SHOULD BE MEASURED 2 FEET (0.6 M) ABOVE THE BOILER VENT COLLAR.

⚠ WARNING

THE INSTRUCTIONS IN THIS SECTION ON VENTING THE BOILER MUST BE FOLLOWED TO AVOID CHOKED COMBUSTION OR RECIRCULATION OF FLUE GASES. SUCH CONDITIONS CAUSE SOOTING OR RISKS OF FIRE AND ASPHYXIATION.

This boiler is approved to be vented as a Category I, Category III (horizontal venting), or a Direct Vent appliance. The Horizontal and Direct Venting options require a special vent kit.

STANDARD (VERTICAL) VENTING, CATEGORY I

THIS BOILER MAY BE VENTED ACCORDING TO TABLE 10 (ALSO SEE FIGURE 6). AT LEAST TYPE B VENTING MUST BE USED WITH THE STANDARD VENTING OPTION (thru-the-roof) USING THE NATIONAL FUEL GAS CODE VENT TABLES. TYPE B VENT PIPE CANNOT BE USED IF THE BOILER IS VENTED HORIZONTALLY OR AS A DIRECT VENT (SEE PAGES 12 THROUGH 15). ALL LOCAL UTILITY, STATE/ PROVINCIAL, REGULATIONS ON VENTING MUST BE FOLLOWED.

VENT SIZING, VENT CONNECTORS, INSTALLATION AND TERMINATION SHALL BE IN ACCORDANCE WITH THE CURRENT EDITION OF NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA-B149.1 or applicable provisions of the local building codes. Size and install proper size vent pipe; refer to Table 6.

Horizontal runs of vent pipe shall be securely supported by adequately placed (approximately every 4 feet [1.2 m]), noncombustible hangers suitable for the weight and design of the materials employed to prevent sagging and to maintain a minimum upward slope of 1/4" per foot (2 cm/m) from the boiler to the vent terminals. Dampers or other obstructions must not be installed in the vent. Be sure that the vent connector does not extend beyond the inside wall of the chimney.

TABLE 6: VENT CONNECTION

MODEL NUMBER	VENT CONNECTOR
G(B,W) 1000	10" (25.4 cm)
G(B,W) 1300	12" (30.5 cm)
G(B,W) 1500	12" (30.5 cm)
G(B,W) 1850	14" (35.6 cm)
G(B,W) 2100	14" (35.6 cm)
G(B,W) 2500	16" (40.6 cm)

For vent arrangements other than Table 10 and for proper boiler operation, a barometric damper is required to maintain draft between -0.02" W.C.. and -0.04" W.C. at 2 feet (0.6 m) above the boiler vent collar.

STANDARD (HORIZONTAL) VENTING, CATEGORY III

Vent sizing, installation and termination shall be in accordance with the NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA-B149.1 (Current Editions). If applicable, all local, utility, state/provincial regulations on venting must be followed. See Table 11, Figure 7 for venting specifications. The exhaust vent pipe must be of a type listed for use with Category III gas burning heaters such as "Saf-T-Vent" manufactured by Heat-Fab Inc.

For Category III installations, it is important that the Installed vent be airtight. Please insure that all joints are sealed properly during installation. For Horizontal Vent Kit part numbers, see Table 7.

TABLE 7: HORIZONTAL VENT KITS.

HORIZONTAL VENT KIT	MODEL
211426	G(B,W) 1000
211426-1	G(B,W) 1300
211426-1	G(B,W) 1500
211426-2	G(B,W) 1850
211426-2	G(B,W) 2100
211426-3	G(B,W) 2500

DIRECT VENT VERTICAL AND HORIZONTAL VENTING

For direct vent applications, this boiler may be vented according to Tables 12 and 13; see Figures 8 and 9. For category III applications,

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the exhaust vent pipe must be listed for use with category III gas burning heaters such as "Saf-T-Vent" manufactured by Heat-Fab Inc. This vent system must be 100% sealed with a condensate trap located as close to the boiler as possible. When sizing exhaust piping and intake air piping, 90-degree elbows are equivalent to 10 feet (3.1 m) of straight pipe and 45-degree elbows are equal to 5 feet (1.5 m) of straight pipe.

The intake air piping can be PVC, CPVC, ABS, Galvanized steel or any suitable intake air piping that can be sealed. See Table 8 for Direct Vent Kit numbers.

TABLE 8: DIRECT VENT KITS.

HORIZONTAL DIRECT VENT KIT NO.	MODEL
211090	G(B,W) 1000
211090-1	G(B,W) 1300
211090-1	G(B,W) 1500
211090-4	G(B,W) 1850
211090-2	G(B,W) 2100
211090-3	G(B,W) 2500
VERTICAL DIRECT VENT KIT NO.	**MODEL**
211089	G(B,W) 1000
211089-1	G(B,W) 1300
211089-1	G(B,W) 1500
211089-4	G(B,W) 1850
211089-2	G(B,W) 2100
211089-3	G(B,W) 2500
AIR INTAKE TERMINAL	**MODEL**
191965-2	G(B/W) 1000
211336	G(B/W) 1300,1500,1850
211336-1	G(B/W) 2100, 2500

HORIZONTAL VENT INSTALLATION

This boiler can be vented through the rear of the cabinet with the use of the fluebox and vent adaptor. Any of the previous venting configurations can be installed with rear connections.

To change the unit to rear exhaust:

1. The vent collar and cover plates must be removed from the top and rear of the unit.

2. Trim the insulation from around the rear flue hole in the jacket and the fluebox. Support insulation from inside the fluebox to facilitate cutting. Use safety precautions such as gloves. Place the gasket and vent adaptor in the horizontal position. Place the gasket and flue plate in the vertical position as shown in Figure 4.

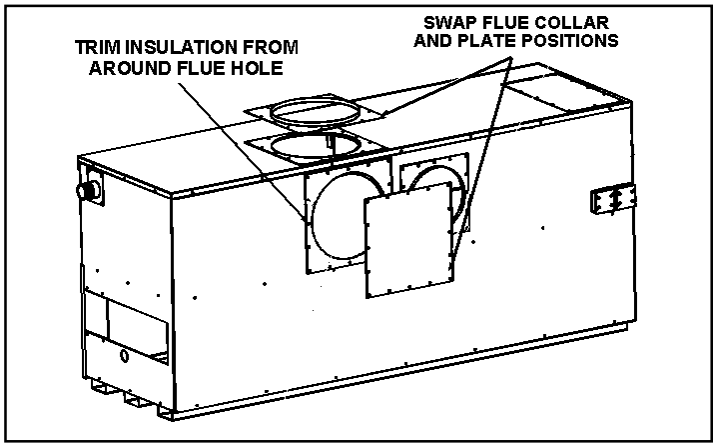

Figure 4. Switching from Vertical to Horizontal Venting.

POWER VENT (OPTIONAL)

The length of vent used in horizontally vented installations can be extended beyond the lengths shown in Tables 11 and 13 by implementing the kits listed below:

TABLE 9: POWER VENT KITS.

POWER VENT KIT NO.	MODEL	MAX. LENGTH
211499	G(B,W) 1000	110' (33.5 m)
211499-1	G(B,W) 1300	100' (30.5 m)
211499-1	G(B,W) 1500	100' (30.5 m)
211499-2	G(B,W) 1850	100' (30.5 m)
211499-3	G(B,W) 2100	100' (30.5 m)
211499-4	G(B,W) 2500	100' (30.5 m)

CONNECTING BOILER TO A COMMON VENT

Do not connect the boiler to a common vent or chimney with solid fuel burning equipment. This practice is prohibited by most local building codes as is the practice of venting gas fired equipment to the duct work of ventilation systems.

Where a separate vent connection is not available and the vent pipe from the boiler must be connected to a common vent with an oil burning furnace, the vent pipe should enter the common vent or chimney at a point ABOVE the flue pipe from the oil furnace.

UL/ULC listed double wall type B-1 gas vents, through 16" diameter, can be installed in heated and unheated areas and can pass through floors, ceilings, partitions, walls and roofs, provided the required clearance is observed.

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system. Perform these steps while the other appliances remaining connected to the common venting system are not in operation.

1. Seal any unused opening in the common venting system.

2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion or other unsafe condition.

3. Insofar as is practical, close all building doors, windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4. Test fire the appliance(s) being inspected, making sure to follow the manufacturers lighting and operating instructions. Appliance(s) operating controls should be adjusted to provide continuous service.

5. Check vent pressure of the appliance 24 inches (61.0 cm) above boiler vent collar. Vent pressure should be maintained between -0.02" W. C. and -0.04" W.C. to assure proper operation. For appliances with a draft hood, check for spillage with mirror, smoke or other device five minutes after placing appliance in operation.

6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans,

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fireplace dampers and other gas burning appliances to their previous conditions of use.

All boiler venting systems shall be installed in accordance with the National Fuel Gas Code, ANSI Z223.1 or CAN/CSA-B149.1 (current edition), or applicable provisions of the local building codes.

INTAKE / EXHAUST INSTALLATION REQUIREMENTS

1. The termination must be 12 inches (30.5 cm) above snow or grade level whichever is higher.

2. Due to normal formation of water vapor in the combustion process, horizontal terminations must not be located over areas of pedestrian or vehicular traffic, i.e. public walkways or over areas where condensate could create a nuisance or hazard. This is especially true in colder climates where ice buildup is likely to occur. A.O. Smith Corporation will not be held liable for any personal injury or property damage due to any dislodging of ice.

3. The exhaust terminal of the venting system must maintain a minimum clearance of 4 feet (1.22 m) horizontally from, and in no case above or below, unless a 4-foot horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.

4. The minimum distance from inside corner formed by two exterior walls is 6 feet (1.8 m) but 10 feet (3.1 m) is recommended where possible.

5. Maintain a minimum distance of 4 feet (1.2 m) from any soffit or eve vent to the exhaust terminal.

6. Maintain a minimum distance of 10 feet (3.1 m) from any forced air inlet. Fresh air or make up air inlet such as a dryer or furnace area is considered to be a forced air inlet.

7. Avoid areas where condensate drainage may cause problems such as above planters, patios, or adjacent to windows where the steam from the flue gases may cause fogging.

8. Select the point of wall penetration where the minimum 1/4" per foot (2 cm/m) of slope up can be maintained.

9. The through the wall termination kit is suitable for zero clearance to combustible materials.

10. The mid point of the termination elbow must be a minimum of 12 inches (30.5 cm) from the exterior wall.

SYSTEM INSTALLATION

GENERAL

If the system is to be filled with water for testing or other purposes during cold weather and before actual operation, care must be taken to prevent a down draft entering the boiler or freezing air from contacting the system. Failure to do so may cause the water in the system to freeze with resulting damage to the system. Damage due to freezing is not covered by the warranty.

Good practice requires that all piping, etc., be properly supported.

The boilers described in this manual may be used for space (hydronic) heating or for the heating of potable water. If the heater is to be used for hydronic space heating, follow the instructions on pages 16-17 given for equipment required for installation as in Figure 10. However, if units are to be used for heating potable water, the information describing specific systems is found on pages 18-20; see Figures 11 and 13. Installations must comply with all local codes.

INSTALLATION AS BOILER REPLACEMENT

Installation as boiler replacement on an old system with large water

⚠ CAUTION

DIRECT VENTING INTO DEAD AIR SPACES SUCH AS ALLEYS, ATRIUMS AND INSIDE CORNERS CAN CAUSE RECIRCULATION OF FLUE GASES. RECIRCULATION OF FLUE GASES WILL CAUSE SOOTING, PREMATURE FAILURE OF THE HEAT EXCHANGER AND ICING OF THE COMBUSTION AIR INTAKE DURING SEVERE COLD WEATHER. TO PREVENT THE RECIRCULATION OF FLUE GASES, MAINTAIN AS MUCH DISTANCE AS POSSIBLE BETWEEN THE COMBUSTION AIR INTAKE AND THE EXHAUST VENT TERMINAL.

Note: Venting system of other than direct-vent appliance shall terminate at least 4 ft. (1.2 m) below, 4 ft. (1.2 m) horizontally from, or 1 ft. (30.0 cm) above any door window or gravity air inlet.

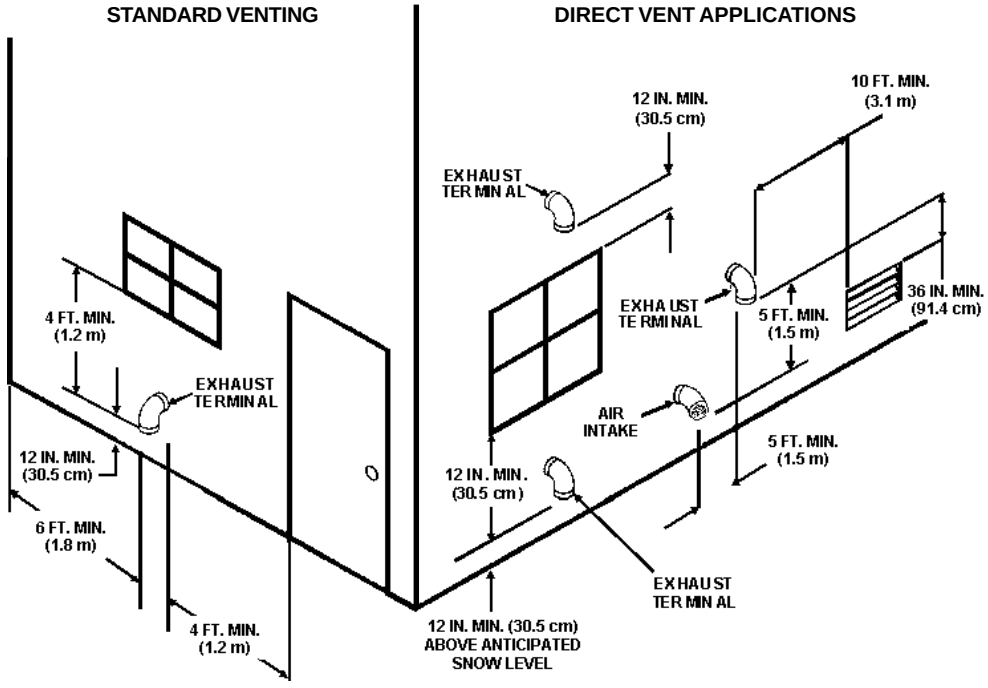
STANDARD VENTING
DIRECT VENT APPLICATIONS
4 FT. MIN. (1.2 m)
EXHAUST TERMINAL
12 IN. MIN. (30.5 cm)
6 FT. MIN. (1.8 m)
4 FT. MIN. (1.2 m)
12 IN. MIN. (30.5 cm)
EXHAUST TERMINAL
10 FT. MIN. (3.1 m)
EXHAUST TERMINAL
5 FT. MIN. (1.5 m)
36 IN. MIN. (91.4 cm)
AIR INTAKE
5 FT. MIN. (1.5 m)
12 IN. MIN. (30.5 cm)
EXHAUST TERMINAL
12 IN. MIN. (30.5 cm) ABOVE ANTICIPATED SNOW LEVEL

Figure 5. Vent Termination Installation Clearances

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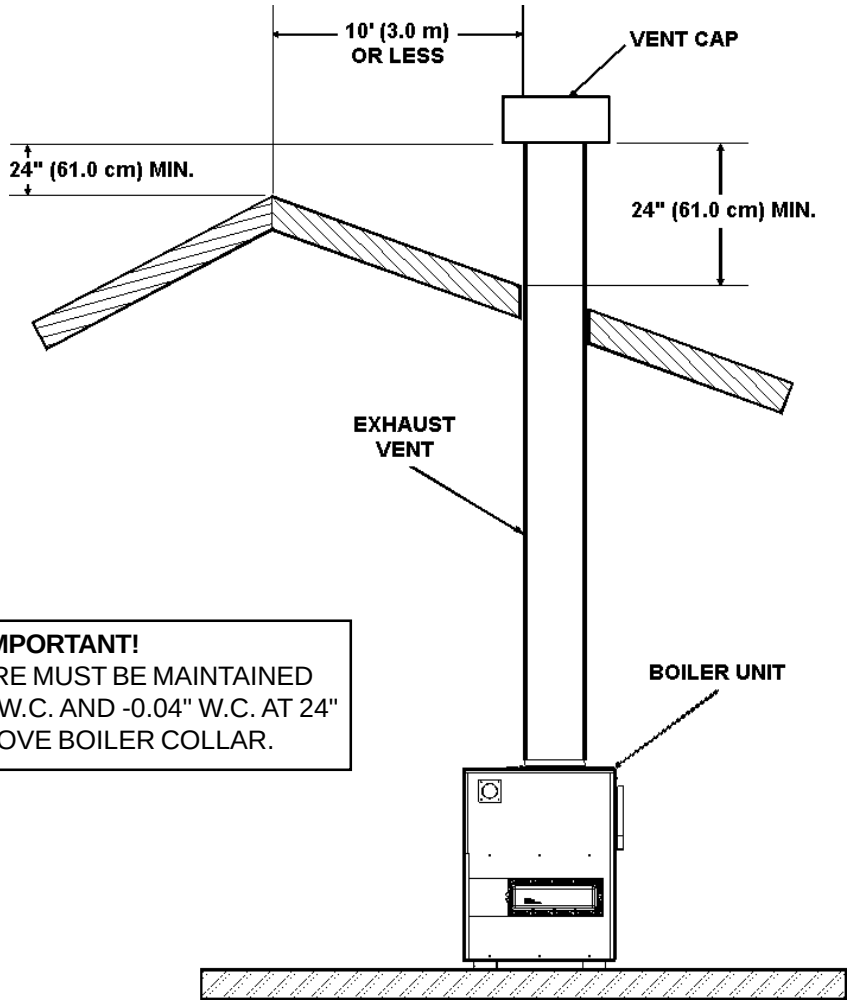
STANDARD VENT - VERTICAL (CATEGORY I)



IMPORTANT!
VENT PRESSURE MUST BE MAINTAINED BETWEEN -0.02" W.C. AND -0.04" W.C. AT 24" (61.0 cm) ABOVE BOILER COLLAR.

Figure 6.

TABLE 10. STANDARD VERTICAL VENTING (CATEGORY I)

MODEL	APPLIANCE CATEGORY	CERTIFIED VENTING MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM LENGTH WITHOUT BAROMETRIC DAMPER FEET (m)
I000	I	TYPE B OR EQUIVALENT	10"(25.4 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper
1300 1500	I	TYPE B OR EQUIVALENT	12" (30.5 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper
1850 2100	I	TYPE B OR EQUIVALENT	14"(35.6 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper
2500	I	TYPE B OR EQUIVALENT	16" (40.6 cm)	35 Feet (10.7 m) without damper *70 Feet (21.3 m) max. with damper

*** Extending venting over 70 feet (21.3 m) may require special considerations.**

• Connection for the appliance exhaust vent to the stack must be as direct as possible. Maximum and minimum venting length for Category I appliances shall be determined per the latest edition of the National Fuel Code (U.S.) and CAN/CSA-B149.1 Installation Code (Canada).

• The horizontal breaching of a vent must have an upward slope of not less than 1/4 inch per linear foot (2 cm/m) from the boiler to the vent terminal. The horizontal portion of the vent shall be supported to maintain clearances and to prevent physical damage or separation of joints.

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STANDARD VENT - HORIZONTAL (CATEGORY III)

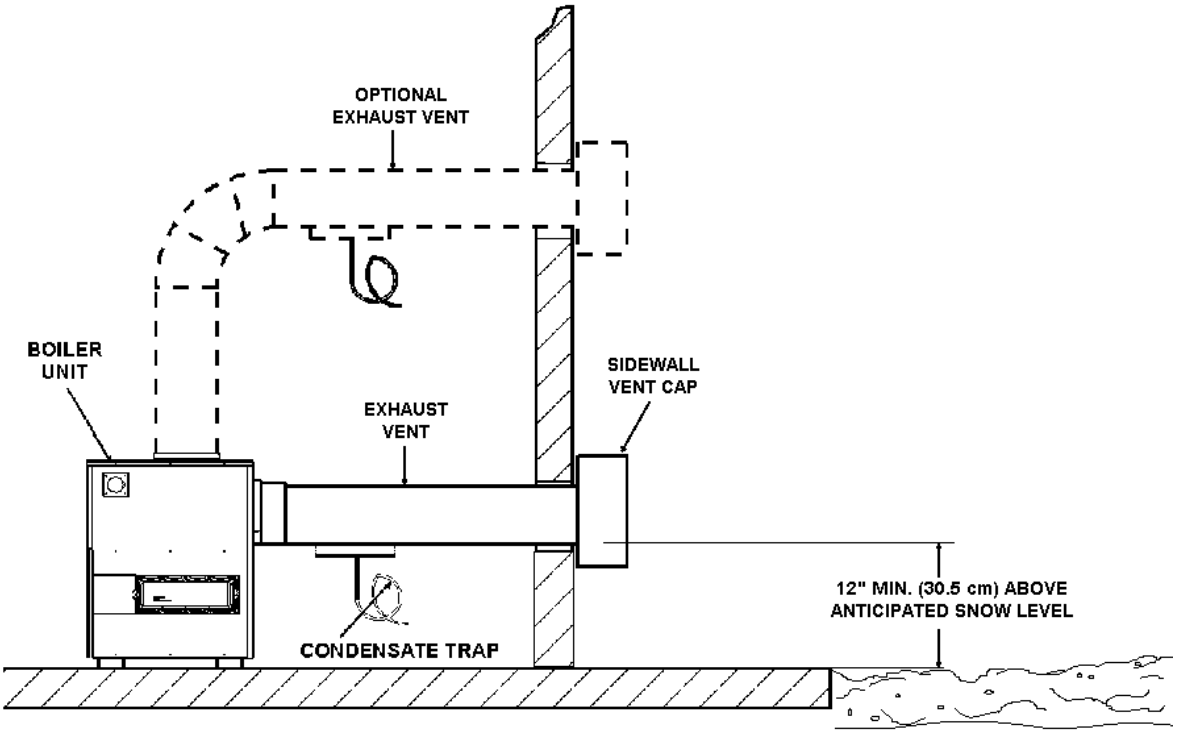

Figure 7.

TABLE 11. STANDARD HORIZONTAL VENTING (CATEGORY III)

MODEL	APPLIANCE CATEGORY	CERTIFIED VENTING MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM VENT LENGTH FEET (m)
I000	III	STAINLESS STEEL	10”(25.4 cm)	70' (21.3 m)
1300 1500	III	STAINLESS STEEL	12" (30.5 cm)	70' (21.3 m)
1850 2100	III	STAINLESS STEEL	14"(35.6 cm)	35' (10.7 m)
2500	III	STAINLESS STEEL	16" (40.6 cm)	35' (10.7 m)

WARNING: No substitutions of flue pipe or vent cap material are allowed. Such substitutions would jeopardize the safety and health of inhabitants.

• A maximum of two elbows can be used on inlet and outlet vent piping respectively. Each elbow is equal to 10 feet (3 m) of straight pipe.

• Use only special gas vent pipes listed for use with Category III gas burning heaters, such as stainless steel Saf-T-Vent by Heat Fab, Inc., available from A.O. Smith, 500 Tennessee Waltz Parkway, Ashland City, TN 37015 Phone: 1-800-433-2545 or Fax: 1-800-433-2515. Pipe joints must be positively sealed.

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DIRECT VENT - VERTICAL (CATEGORY I)

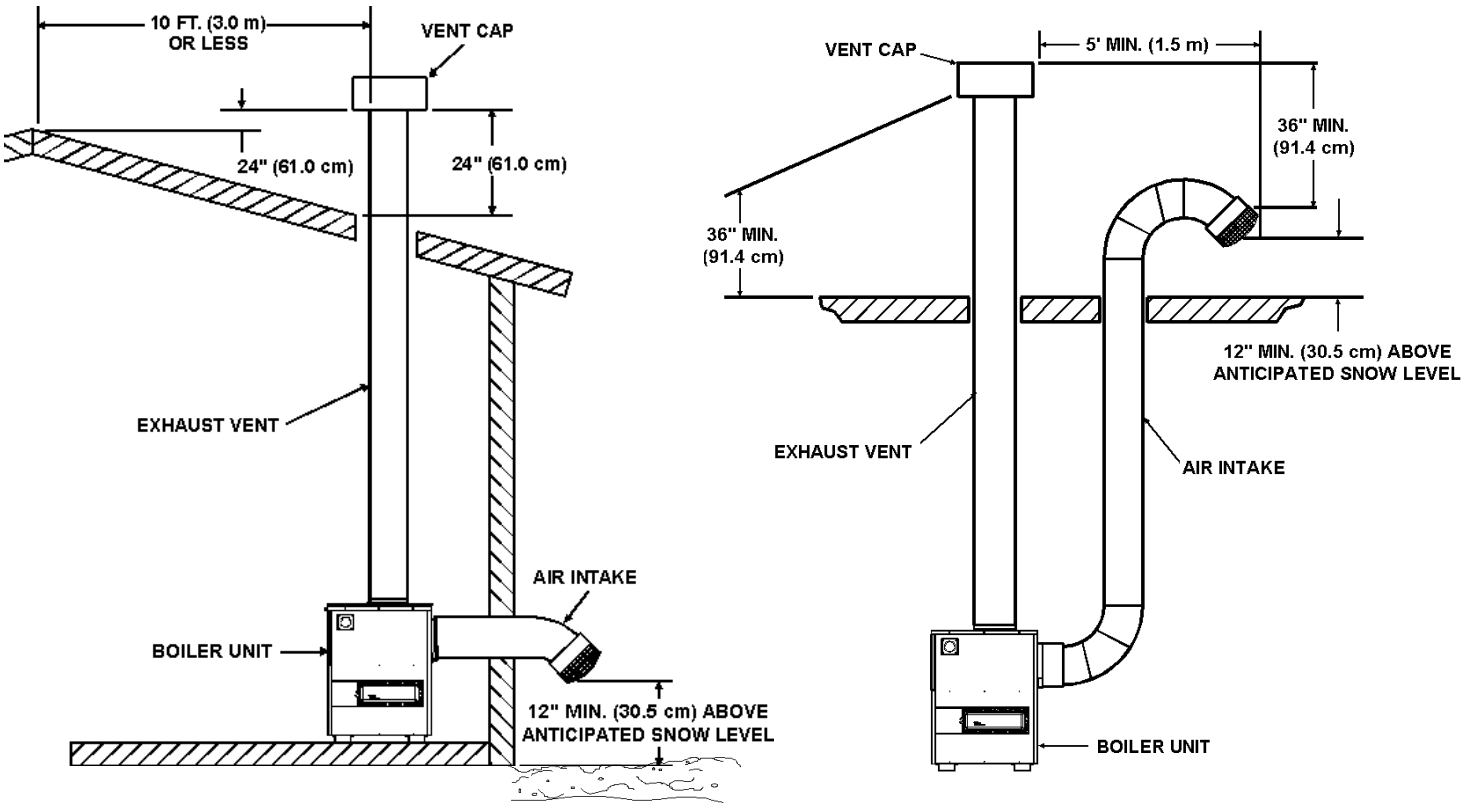

Figure 8.

TABLE 12. DIRECT VENT (VERTICAL EXHAUST CONFIGURATIONS)

MODEL	APPLIANCE CATEGORY	CERTIFIED EXHAUST VENT MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM EXHAUST VENT LENGTH FT (m)	AIR INTAKE MATERIAL	AIR INTAKE SIZE INCHES (cm)	MAXIMUM AIR INTAKE LENGTH FT (m)
I000	I	TYPE B OR EQUIVALENT	10" (25.4 cm)	35' (10.7 m)	GAL. STEEL PVC, ABS OR CPVC	8" (20.3 cm)	35' (10.7 m)
1300 1500	I	TYPE B OR EQUIVALENT	12" (30.5 cm)	35' (10.7 m)	GAL.STEEL PVC, ABS CR CPVC	10" (25.4 cm)	35' (10.7 m)
1850	I	TYPE B OR EQUIVALENT	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	10" (25.4 cm)	20' (6.1 m)
2100	I	TYPE B OR EQUIVALENT	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)
2500	I	TYPE B OR EQUIVALENT	16" (40.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)

• Connection for the appliance exhaust vent to the stack must be as direct as possible. Maximum and minimum venting length for Category I appliances shall be determined per the latest edition of the National Fuel Code (U.S.) and CAN/CSA-B149.1 Installation Code (Canada).

• The vent should be installed so as to prevent the accumulation of condensate and, where necessary, have means provided for drainage of condensate. The horizontal breaching of a vent must have an upward slope of not less than 1/4 inch per linear foot (2 cm/m) from the boiler to the vent terminal. The horizontal portion of the vent shall be supported to maintain clearances and to prevent physical damage or separation of joints.

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DIRECT VENT - HORIZONTAL (CATEGORY III)

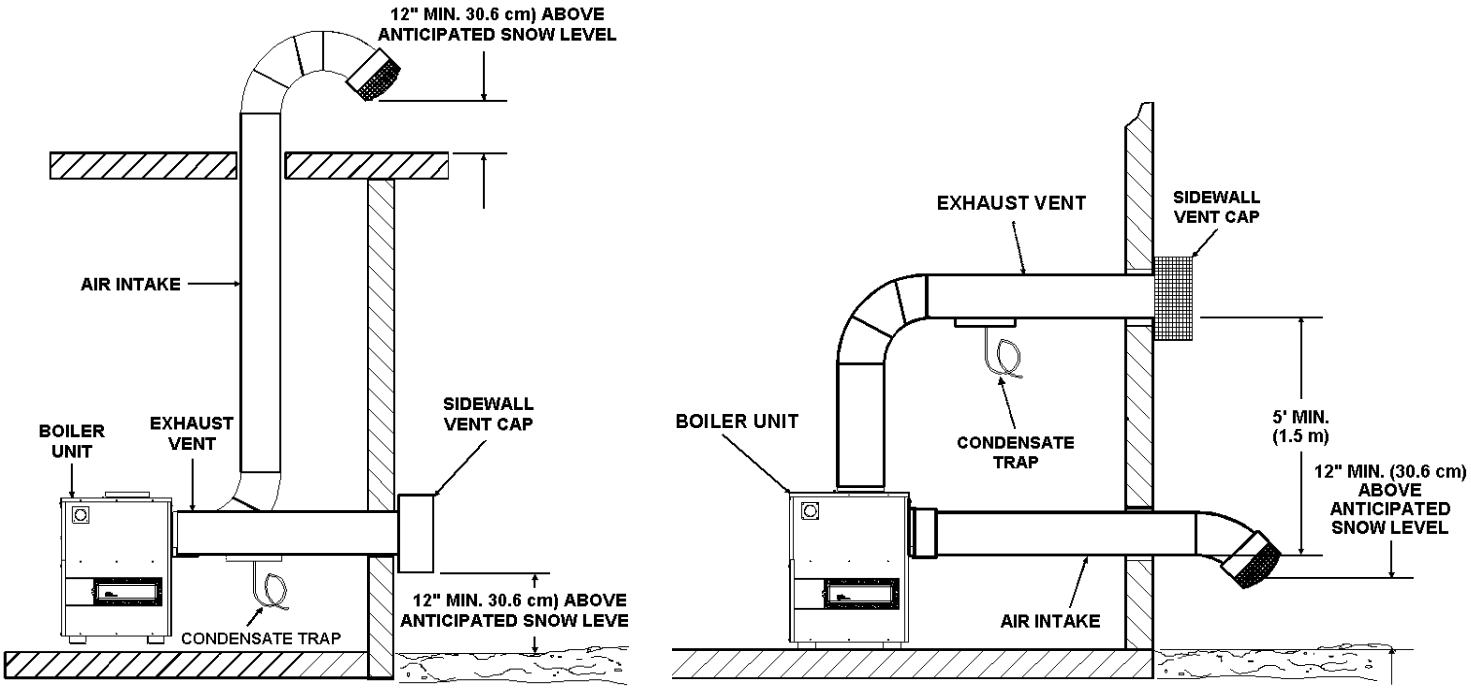

Figure 9.

TABLE 13. DIRECT VENT (HORIZONTAL EXHAUST CONFIGURATIONS)

MODEL	APPLIANCE CATEGORY	CERTIFIED EXHAUST VENT MATERIAL	EXHAUST VENT SIZE INCHES (cm)	MAXIMUM EXHAUST VENT LENGTH FT (m)	AIR INTAKE MATERIAL	AIR INTAKE SIZE INCHES (m)	MAXIMUM AIR INTAKE LENGTH FT (m)
I000	III	STAINLESS (SEALED)	10" (25.4 cm)	35' (10.7 m)	GAL. STEEL PVC, ABS OR CPVC	8" (20.3 cm)	35' (10.7 m)
1300 1500	III	STAINLESS (SEALED)	12" (30.5 cm)	35' (10.7 m)	GAL.STEEL PVC, ABS CR CPVC	10" (25.4 cm)	35' (10.7 m)
1850	III	STAINLESS (SEALED)	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	10" (25.4 cm)	20' (6.1 m)
2100	III	STAINLESS (SEALED)	14" (35.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)
2500	III	STAINLESS (SEALED)	16" (40.6 cm)	20' (6.1 m)	GAL. STEEL PVC, ABS OR CPVC	12" (30.5 cm)	20' (6.1 m)

WARNING: No substitutions of flue pipe or vent cap material are allowed. Such substitutions would jeopardize the safety and health of inhabitants.

• A maximum of two elbows can be used on inlet and outlet vent piping respectively. Each elbow is equal to 10 feet (3 m) of straight pipe.

• Use only special gas vent pipes listed for use with Category III gas burning heaters, such as stainless steel Saf-T-Vent by Heat Fab, Inc. Inc., available from A.O. Smith, 500 Tennessee Waltz Parkway, Ashland City, TN 37015 Phone: 1-800-433-2545 or Fax: 1-800-433-2515. Pipe joints must be positively sealed.

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volume may result in condensation within the boiler on cold starts. This condensing of water vapor in the combustion area can be prevented if a portion of the system water flow is diverted past the boiler to cause an increase in boiler temperature.

BYPASS BALANCING

With systems where water temperature can be expected to drop appreciably due to long standby periods, or heavy draw down, a bypass pipe of at least 1" size with a balancing cock should be installed between the boiler inlet and outlet. See Figure 10. When the system first starts, the valve should be slowly opened until the condensing ceases. This adjustment remains at a permanent setting to establish required temperature rise across the boiler.

AIR SEPARATOR

An air separator as shown in the piping diagram is recommended especially for modern commercial hydronic systems.

VENT VALVES

It is recommended that automatic, loose key or screwdriver type vent valves be installed at each convector or radiator.

SYSTEM HEADERS

Split systems with individual supply and return lines from the boiler room should normally have this piping connected to supply and return manifold headers near the boiler. To achieve good water distribution with minimum pressure drop for several circuits, manifolds should be larger than system loops.

The circuits should be spaced on the header at a minimum of 3" (7.6 cm) center to center. Install a balancing cock in each return line.

Manifold headers are recommended for split systems with or without zone valves and also those installations with zone circulators. If the system is to be split at remote points, good practice requires special attention be given to main pipe sizing to allow balancing of water flow.

COOLING PIPING

When the boiler is used in conjunction with a refrigeration system it must be installed so that the chilled medium is piped in parallel with the boiler. Appropriate valves, manual or motorized, must be provided to prevent the chilled medium from entering the boiler.

Water temperature in the heating system must be reduced to less than 100°F (38°C) before cooling system is started, or damage to the chiller unit may occur.

If the boiler is connected to chilled water piping or heating coils exposed to refrigerated air, the boiler piping system must be equipped with flow control valves or other automatic means to prevent gravity circulation through the boiler during the cooling cycle. Primary/secondary pumping of both the chiller(s) and the boiler(s) is an excellent winter-summer change-over method, because cooling flow rates are much more than heating flow rates. In this way each system (heating or cooling) is circulated independently.

EXPANSION TANK

Install an expansion tank as shown in Figures 10, 11, and 13. The sizing of the expansion tank is very important and is directly related to the total water volume of the system. Refer to ASME or other reliable specifications for sizing.

HYDRONIC INSTALLATION

The following is a brief description of the equipment required for installations noted in Figure 10. All installations must comply with local codes.

TABLE 14: INSTALLATION ITEMS

NO.	SUGGESTED ITEMS FOR INSTALLATION
1.	PAIR OF SHORT PIPE NIPPLES, PAIR OF BOILER LOOP TEES AND BALL VALVE BETWEEN SYSTEM SUPPLY AND RETURN - ONE SET PER EACH BOILER
2.	BOILER PIPE LOOP (See Table 5.)
3.	BOILER CIRCULATING PUMP (See Table 5.)
4.	THERMOMETER
5.	PRESSURE GAUGE
6.	LOW WATER CUTOFF (If Required By Local Code.)
7.	FLOW SWITCH (Factory-Installed)
8.	PRESSURE RELIEF VALVE (Factory-Installed)
9.	BOILER INLET - OUTLET
10.	SYSTEM SUPPLY TEMPERATURE THERMOMETER
11.	DRAIN or BLOW-DOWN VALVE

WATER SUPPLY LINE

These boilers can be used ONLY in a forced circulation hot water heating system. The pump must be interlocked with the boiler to prevent boiler operation without water circulation. See maximum and minimum flow rate information. Since most forced circulation systems will be of the closed type, install the water supply line as shown on piping diagram. See Figure 10. **Severe damage will occur if the boiler is operated without proper water flow circulation.**

Fast filling of large pipe, old radiator installations (where high pressures are not available) requires bypassing of the pressure reducing valve. Generally, pressure purging is not possible with a well pump system. High point air venting is essential. For details, refer to OPERATION section of this manual. If the system is of the open type, a pressure reducing valve will not be required as the water supply to the system will be controlled by a manually operated valve. An overhead surge tank is required. A MINIMUM PRESSURE OF 15 PSI (100 kPa) MUST BE MAINTAINED ON THE BOILER AT ALL TIMES to avoid potential damage to the boiler that may not be covered by the warranty.

CONVENTIONAL SPACE HEATING INSTALLATION

Modern copper-finned tube type boilers are exceptionally fast heating units. The low water volumes in relation to firing rates require special attention to water flow rates for smooth, efficient operation. These considerations for the A. O. Smith copper heat exchanger boilers are covered below.

Refer to Table 5 showing flow rate vs. pressure drop and temperature rise.

Figure 10 shows a typical installation of the boiler.

A system with several flow controlled zones, or with a 3-way mixing valve system could present a flow rate to the boiler of less than required for a maximum of 50°F (28°C) temperature rise. Design system with compensating bypasses to the boiler.

A system bypass should be installed as shown in Figure 10 to prevent boiler circulation starvation when the system zones call for reduced flow.

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This bypass may also be used with multiple boilers manifolded for reverse-return flow. The system bypass would be installed from boiler outlet to suction side of pump.

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling units where they may be exposed to circulating refrigerated air, must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle. It is highly recommended that the piping be insulated.

SPACE HEATING APPLICATIONS

Controlling of these systems is decided mainly by the type of building system controlling that is desired. A single boiler installation might be controlled directly from space temperature thermostat(s). Multiple boiler installations are more effective when the boilers are sequenced in and out of operation by some form of main water temperature controller. With one or two boilers, individual control settings at progressive temperature may be used. For more than two boilers, electronic sequencing controlling is recommended.

Individual controls, or the separate stages of a step controller, should start the boiler loop circulator and fire the boiler. Some large installations may require the firing of more than one boiler per stage.

The system or primary circulator may or may not be controlled by the boiler sequencer. When this pump is operated through the first switch of any type of step controller, care should be taken to determine if a motor starter is needed due to insufficient switch capacity.

Multiple boiler installations are especially adapted to the use of outdoor reset for main water temperatures. This feature is not mandatory but offers smooth, efficient operation of a modern system.

Normal use of flow control valves is required to prevent cross circulation of zones as with any multiple pump system.

Large systems with multiple boilers should include main water temperature controls (with or without outdoor reset) to sequence the boiler on and off, in relation to the load on the system.

24 VAC System Controller (Optional)

GB models require a field supplied 24VAC operating control to be installed in the system such as: loop thermostat, indoor/outdoor reset control, sequencing panel, or energy management system. The connection for such devices is located in the 24 VAC junction box at the rear of the unit. A 24 VAC thermostat/aquastat can only be used as an "On/Off" switch for the unit. The actual controlling of the staging will be through either the inlet or tank probe.

INTERNAL CONTAMINANTS

The system must be internally cleaned and flushed after a new or replacement unit has been installed to remove contaminants that may have accumulated during installation. This is doubly important when a replacement unit is installed into an existing system where Stop Leak or other boiler additives have been used.

All systems should be completely flushed with a grease removing solution to assure trouble-free operation. Pipe joint compounds, soldering paste, grease on tubing and pipe all tend to contaminate a system.

Failure to clean and flush the system can cause solids to form on the inside of the heat exchanger, can produce acid concentrations that become corrosive, can allow excessive amounts of air or other gases to form which could block circulation, foul system accessories and damage circulator seals and impellers.

It is recommended that after installation, the boiler and system when filled should include the proper percentage of cleaning solution

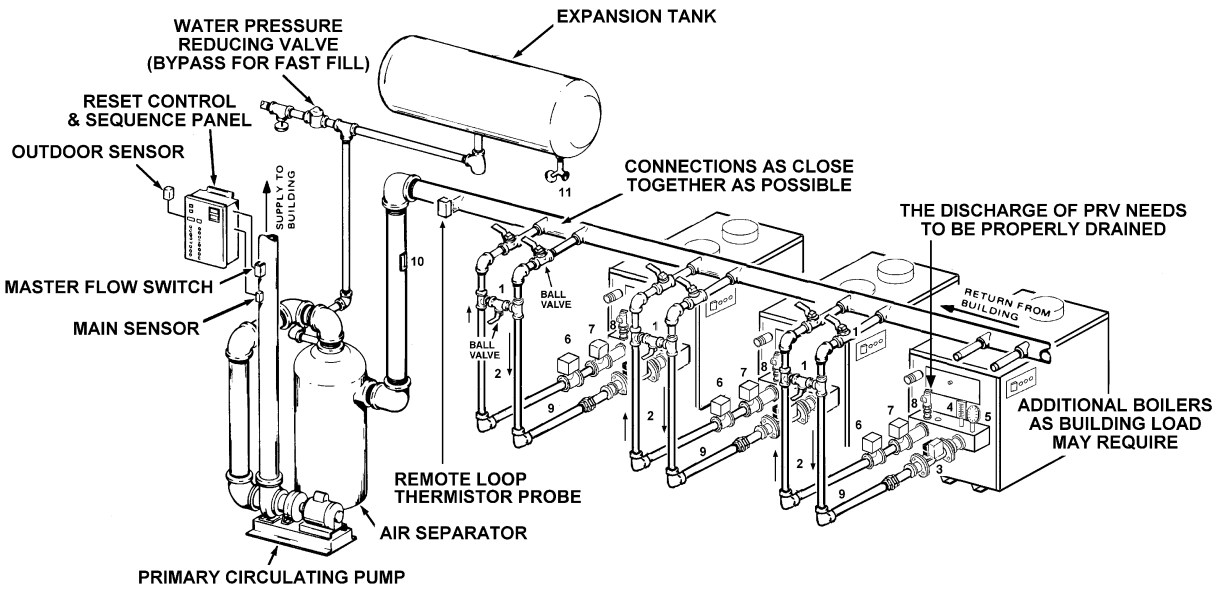
EXPANSION TANK
WATER PRESSURE REDUCING VALVE (BYPASS FOR FAST FILL)
RESET CONTROL & SEQUENCE PANEL
OUTDOOR SENSOR
SUPPLY TO BUILDING
CONNECTIONS AS CLOSE TOGETHER AS POSSIBLE
THE DISCHARGE OF PRV NEEDS TO BE PROPERLY DRAINED
MASTER FLOW SWITCH
MAIN SENSOR
BALL VALVE
RETURN FROM BUILDING
ADDITIONAL BOILERS AS BUILDING LOAD MAY REQUIRE
REMOTE LOOP THERMISTOR PROBE
AIR SEPARATOR
PRIMARY CIRCULATING PUMP

Figure 10. Single or Multiple Boiler Installation Diagram

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related to approximate water volume of the system. The system should be turned on to circulate water mix for about one hour and then flush clean with fresh water.

Before operating the boiler, the entire system must be filled with water, purged of air and checked for leaks. Do not use Stop Leak or other boiler compounds.

THE WATER HEATER SHOULD BE LOCATED IN AN AREA WHERE THE GENERAL PUBLIC DOES NOT HAVE ACCESS TO BOILER CONTROLS.

HOT WATER SUPPLY BOILER INSTALLATION

WATER LINE CONNECTIONS

Where excessive heat exchanger condensation exists due to continued low inlet water temperatures below 120°F (49°C), a bypass balance loop must be installed. See Figures 10 and 12.

HARD WATER CONDITIONS

Where hard water conditions exist, water softening or the threshold type of water treatment is recommended. This will protect the dishwashers, coffee urns, water heaters, water piping and other equipment. When water softening or water treatment is not practical, a comparatively easy method of periodic lime removal from the unit must be employed.

⚠ WARNING

LIME ACCUMULATION CAN REDUCE THE LIFE OF THE EQUIPMENT, REDUCE EFFICIENCY AND WASTE FUEL. BOILER FAILURE DUE TO LIME OR SCALE BUILDUP VOIDS THE WARRANTY.

Tank Probe (Optional)

In addition to the Inlet and Outlet/ECO Probes, units can be optionally equipped with a tank probe. The connection for the tank probe is located in the 24VAC junction box at the rear of the unit. The tank probe can be configured to control the staging of the unit. See "Tank Probe Installation Procedure" section below for additional information.

TANK PROBE INSTALLATION PROCEDURE

A tank probe is supplied with each hot water supply boiler (GW). To connect the tank probe to the boiler, remove the cover from the 24VAC junction box at the rear of the unit. Connect the probe wires across terminals 1 & 2. (The wires leading to the terminals will be yellow.) Check the field connection diagram located on this cover of the junction box to assure proper wiring.

Once the tank probe has been connected to the boiler, it must be designated as the controlling probe for the system. This is accomplished by changing two Dip Switch settings on the Central Control Board. First, Dip Switch “SW1-4” must be set to the “ON” position to designate the tank probe as the controlling probe. Second, Dip Switch “SW1-1” must be set to the “OFF” position to limit the maximum tank probe temperature for GW applications. Failure to do this will void the warranty. If the tank probe is not designated as the controlling probe, the staging of the unit will be controlled by the inlet probe and will not use the desired tank temperature as its base.

Refer to "Connection Diagram" in order to connect the tank probe to the boiler. See Figures 12 and 15.

See section titled "Temperature Setpoints" for instructions on how to set the temperature.

GAS CONNECTIONS

⚠ WARNING

THIS BOILER IS NOT INTENDED TO OPERATE AT GAS SUPPLY PRESSURE OTHER THAN SHOWN ON THE RATING PLATE. EXPOSURE TO HIGHER GAS SUPPLY PRESSURE MAY CAUSE DAMAGE TO GAS VALVES WHICH CAN RESULT IN FIRE OR EXPLOSION. IF OVERPRESSURE HAS OCCURRED SUCH AS THROUGH IMPROPER TESTING OF GAS LINES OR EMERGENCY MALFUNCTION OF THE SUPPLY SYSTEM, THE GAS VALVES MUST BE CHECKED FOR SAFE OPERATION. MAKE SURE THAT THE OUTSIDE VENTS ON THE SUPPLY REGULATORS AND THE SAFETY VENT VALVES ARE PROTECTED AGAINST BLOCKAGE. THESE ARE PARTS OF THE GAS SUPPLY SYSTEM, NOT THE BOILER. VENT BLOCKAGE MAY OCCUR DURING ICE BUILD-UP OR SNOW STORMS.

WHEN LOCAL CODES REQUIRE A MAIN MANUAL SHUT-OFF VALVE OUTSIDE THE BOILER JACKET, A SUITABLE MAIN MANUAL SHUT-OFF VALVE MUST BE INSTALLED IN A LOCATION COMPLYING WITH THOSE CODES.

IT IS IMPORTANT TO GUARD AGAINST GAS VALVE FOULING FROM CONTAMINANTS IN THE GAS WAYS. SUCH FOULING MAY CAUSE IMPROPER OPERATION, FIRE OR EXPLOSION. IF COPPER SUPPLY LINES ARE USED THEY MUST BE APPROVED FOR GAS SERVICE.

BEFORE ATTACHING THE GAS LINE BE SURE THAT ALL GAS PIPE IS CLEAN ON THE INSIDE.

TO TRAP ANY DIRT OR FOREIGN MATERIAL IN THE GAS SUPPLY LINE, A DIRT LEG (SOMETIMES CALLED DRIP LEG) MUST BE INCORPORATED IN THE PIPING. THE DIRT LEG MUST BE READILY ACCESSIBLE AND NOT SUBJECT TO FREEZING CONDITIONS. INSTALL IN ACCORDANCE WITH RECOMMENDATIONS OF SERVING GAS SUPPLIERS. REFER TO NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA -B149.1 (current edition).

THE BOILER AND ITS INDIVIDUAL SHUTOFF VALVE MUST BE DISCONNECTED FROM THE GAS SUPPLY PIPING SYSTEM DURING ANY PRESSURE TESTING OF THAT SYSTEM AT TEST PRESSURES IN EXCESS OF 1/2 PSI (3.5 KPA).

THE BOILER MUST BE ISOLATED FROM THE GAS SUPPLY PIPING SYSTEM BY CLOSING ITS INDIVIDUAL MANUAL SHUTOFF VALVE DURING ANY PRESSURE TESTING OF THE GAS SUPPLY PIPING SYSTEM AT TEST PRESSURES EQUAL TO OR LESS THAN 1/2 PSI (3.5KPA).

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ONE GENESIS (MODEL GW) HOT WATER SUPPLY BOILER WITH HORIZONTAL TANK

INSTALL THERMAL EXPANSION TANK ON COLD WATER SUPPLY LINE, IF CHECK VALVE OR PRESSURE REDUCING VALVE IS USED IN SUPPLY.

DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE WATER TEMPERATURE CONTROL WARNING ON PAGE 26. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

WARNING

THE WATER MANIFOLD IS NOT DESIGNED TO SUPPORT THE WEIGHT OF THE WATER PIPING SYSTEM. SPECIAL CARE MUST BE TAKEN TO ENSURE PROPER SUPPORT.

PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

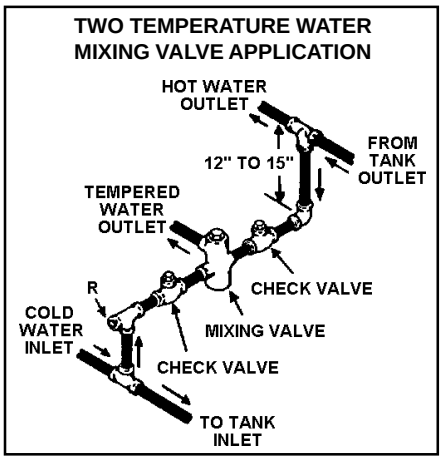
PIPING SHOULD CONFORM TO LOCAL CODES.

BALL VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

IMPORTANT

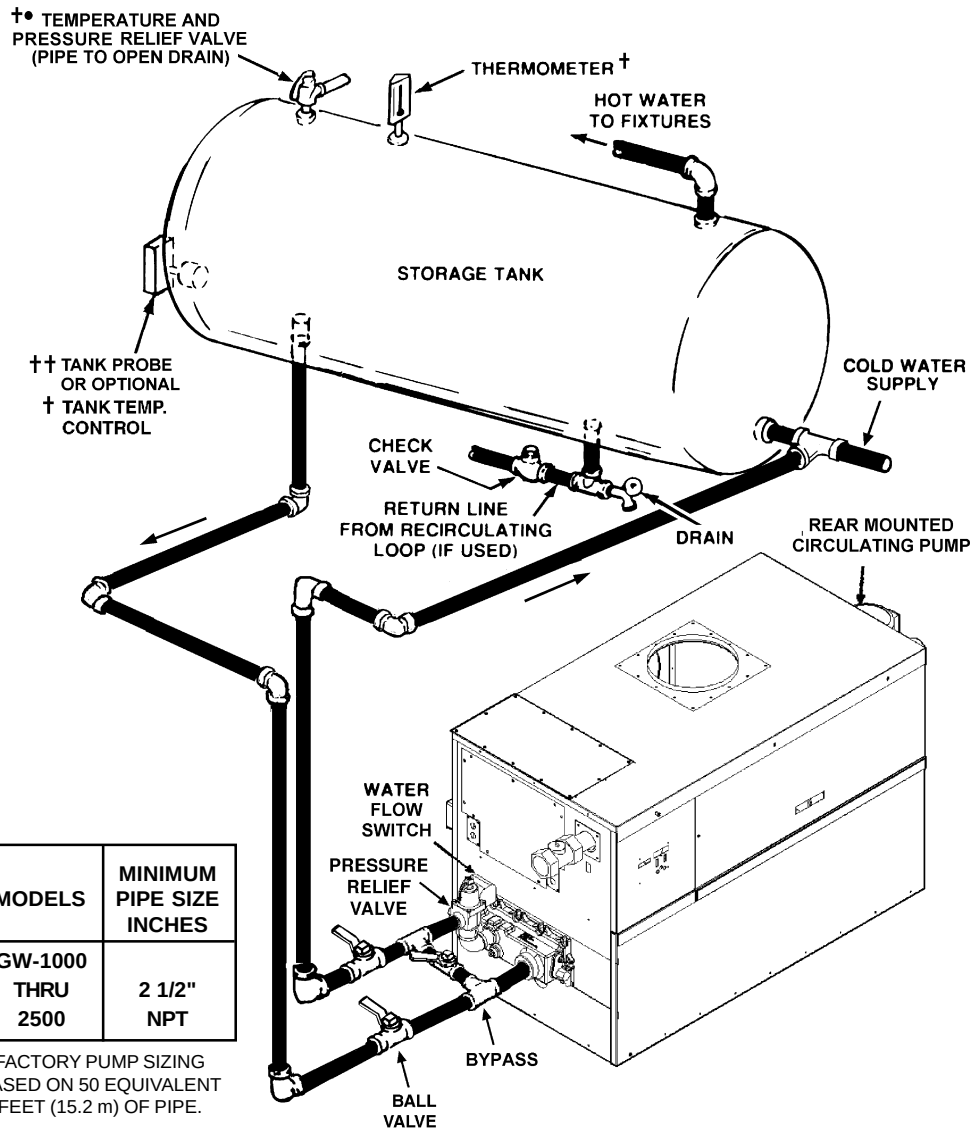
WATER FLOW SWITCH PROTECTS THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

- • PIPE TO OPEN DRAIN
- X FACTORY-INSTALLED ON UNIT
- == SUPPLIED WITH UNIT
- = FIELD-INSTALLED



CIRCULATING RETURN LINE CONNECTIONS

- TEMPERED WATER LOOP, IF USED, CONNECT TO POINT R.
- STORED TEMPERATURE WATER LOOP, IF USED, CONNECT TO ANY OPENING NEAR BOTTOM OF TANK.



MODELS	MINIMUM PIPE SIZE INCHES
GW-1000 THRU 2500	2 1/2" NPT

FACTORY PUMP SIZING BASED ON 50 EQUIVALENT FEET (15.2 m) OF PIPE.

Figure 11. Single boiler with horizontal tank.

Encase field-supplied wires between tank probe and junction box with 1/2" field supplied conduit. "Pigtails" of field-supplied wires should be spliced to "pigtails" of tank probe and connected to 24 VAC junction box. See figure 15. This conduit and wiring should be separate from any other conduit/wiring to guard against EMI (electromagnetic interference).

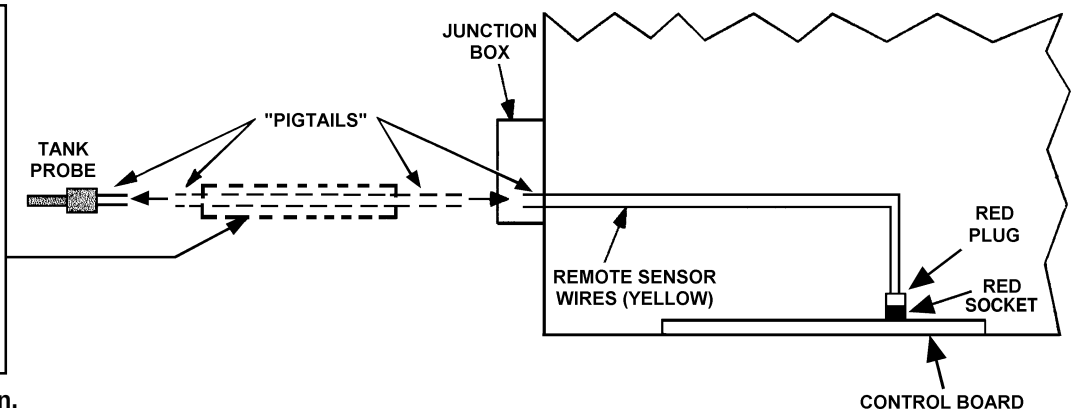


Figure 12. Tank probe installation.

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ONE GENESIS (MODEL GW) HOT WATER SUPPLY BOILER WITH VERTICAL TANK

PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

PIPING SHOULD CONFORM TO LOCAL CODES.

BALL VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

IMPORTANT

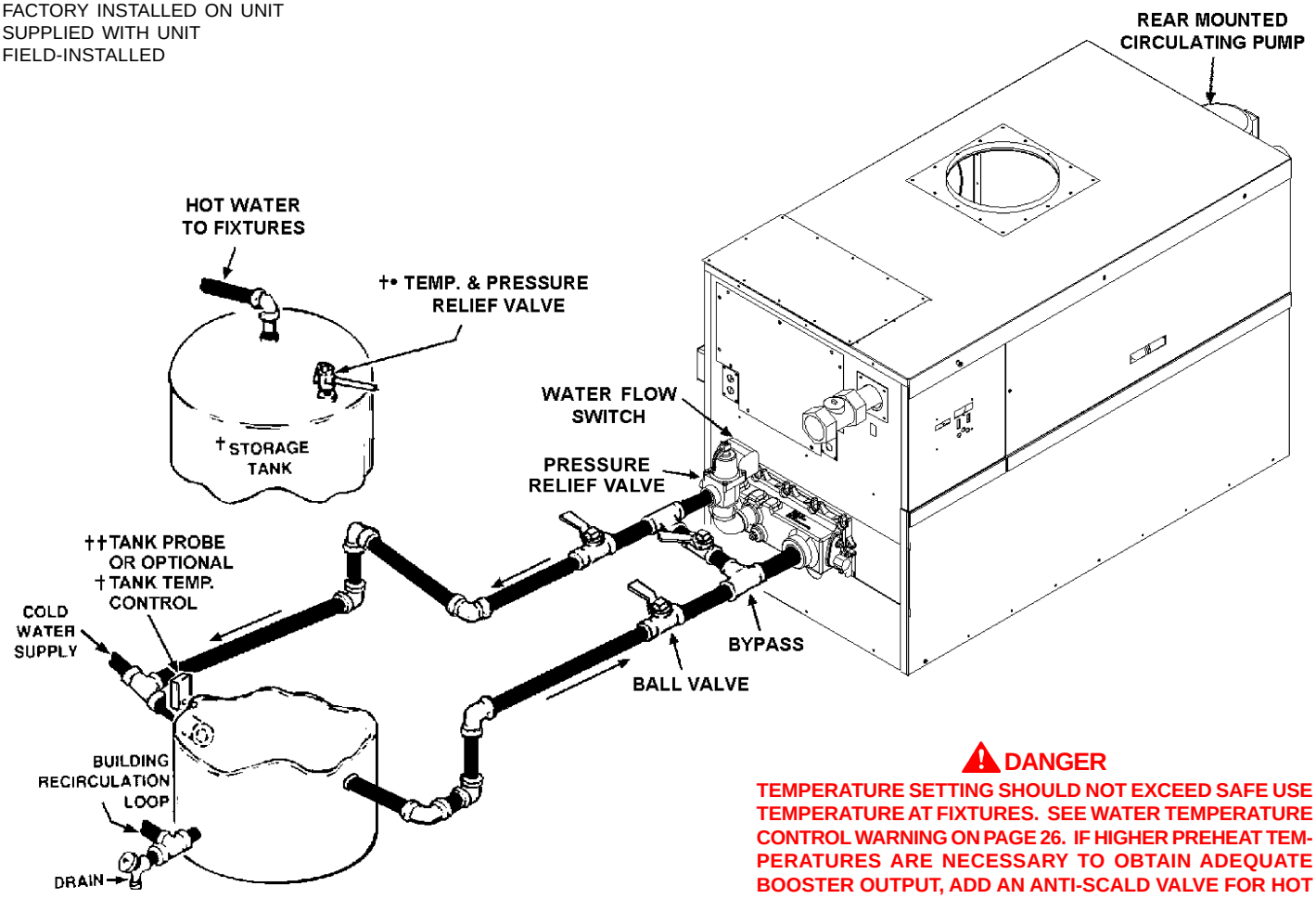
WATER FLOW SWITCH PROTECTS THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE.

- PIPE TO OPEN DRAIN

X FACTORY INSTALLED ON UNIT

== SUPPLIED WITH UNIT

= FIELD-INSTALLED



⚠ DANGER

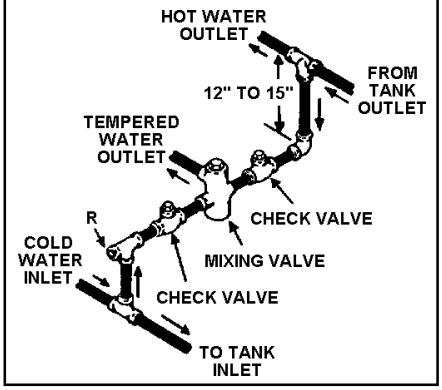
TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE WATER TEMPERATURE CONTROL WARNING ON PAGE 26. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

INSTALL THERMAL EXPANSION TANK ON COLD WATER SUPPLY LINE, IF CHECK VALVE OR PRESSURE REDUCING VALVE IS USED IN SUPPLY.

MODELS	MINIMUM PIPE SIZE INCHES
GW-1000 THRU 2500	2 1/2" NPT

FACTORY PUMP SIZING BASED ON 50 EQUIVALENT FEET (15.2 m) OF PIPE.

TWO TEMPERATURE WATER MIXING VALVE APPLICATION



CIRCULATING RETURN LINE CONNECTIONS

- TEMPERED WATER LOOP, IF USED, CONNECT TO POINT R.
- STORED TEMPERATURE WATER LOOP, IF USED, CONNECT TO ANY OPENING NEAR BOTTOM OF TANK.

Figure 13. Single boiler with vertical tank.

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TABLE 15. Suggested Pipe Size For Multiple Gas Appliances (Natural)

Nominal Iron Pipe Size (Inches)	Maximum Capacity of Pipe in BTU/hr and kW for Gas Pressures of 14 in. W.C. (0.5 psi) or Less and a Pressure Drop of 0.5 in. W.C. (based on 0.60 Specific Gravity Gas w/Heating Value of 1,000 BTU's/Ft³)														
		Length of Pipe in Feet (Metres)													
	Cap.	10 Ft. (3.05)	20 Ft. (6.10)	30 Ft. (9.14)	40 Ft. (12.19)	50 Ft. (15.24)	60 Ft. (18.29)	70 Ft. (21.34)	80 Ft. (24.38)	90 Ft. (27.43)	100 Ft. (30.48)	125 Ft. (38.10)	150 Ft. (45.72)	175 Ft. (53.34)	200 Ft. (60.96)
1 1/4"	BTU/hr	1,400,000	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	410	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1 1/2"	BTU/hr	2,100,000	1,460,000	1,180,000	990,000	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	615	428	346	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2"	BTU/hr	3,950,000	2,750,000	2,200,000	1,900,000	1,680,000	1,520,000	1,400,000	1,300,000	1,220,000	1,150,000	1,020,000	- - -	- - -	- - -
	kW	1,157	805	644	556	492	445	410	381	357	337	299	- - -	- - -	- - -
2 1/2"	BTU/hr	6,300,000	4,350,000	3,520,000	3,000,000	2,650,000	2,400,000	2,250,000	2,050,000	1,950,000	1,850,000	1,650,000	1,500,000	1,370,000	1,280,000
	kW	1,845	1,274	1,031	879	776	703	659	600	571	542	483	439	401	375
3"	BTU/hr	11,000,000	7,700,000	6,250,000	5,300,000	4,750,000	4,300,000	3,900,000	3,700,000	3,450,000	3,250,000	2,950,000	2,650,000	2,450,000	2,280,000
	kW	3,222	2,255	1,830	1,552	1,391	1,259	1,142	1,084	1,010	952	864	776	718	668
4"	BTU/hr	23,000,000	15,800,000	12,800,000	10,900,000	9,700,000	8,800,000	8,100,000	7,500,000	7,200,000	6,700,000	6,000,000	5,500,000	5,000,000	4,600,000
	kW	6,736	4,627	3,749	3,192	2,841	2,577	2,372	2,197	2,109	1,962	1,757	1,611	1,464	1,347

TABLE 16. Suggested Pipe Size For Multiple Gas Appliances (Propane Gas)

Nominal Iron Pipe Size (Inches)	Maximum Capacity of Pipe in BTU/hr and kW for Gas Pressures of 14 in. W.C. (0.5 psi) or Less and a Pressure Drop of 0.5 in. W.C. (based on 1.53 Specific Gravity Gas w/Heating Value of 2,500 BTU's/Ft³)														
		Length of Pipe in Feet (Metres)													
	Cap.	10 Ft. (3.05)	20 Ft. (6.10)	30 Ft. (9.14)	40 Ft. (12.19)	50 Ft. (15.24)	60 Ft. (18.29)	70 Ft. (21.34)	80 Ft. (24.38)	90 Ft. (27.43)	100 Ft. (30.48)	125 Ft. (38.10)	150 Ft. (45.72)	175 Ft. (53.34)	200 Ft. (60.96)
1"	BTU/hr	1,060,800	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	311	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1 1/4"	BTU/hr	2,184,000	1,482,000	1,201,200	1,029,600	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	kW	640	434	352	302	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1 1/2"	BTU/hr	3,276,000	2,277,600	1,840,800	1,544,400	1,404,000	1,263,600	1,170,000	1,076,400	1,014,000	- - -	- - -	- - -	- - -	- - -
	kW	959	667	539	452	411	370	343	315	297	- - -	- - -	- - -	- - -	- - -
2"	BTU/hr	6,162,000	4,290,000	3,432,000	2,964,000	2,620,800	2,371,200	2,184,000	2,028,000	1,903,200	1,794,000	1,591,200	1,482,000	1,326,000	1,248,000
	kW	1,805	1,256	1,005	868	768	694	640	594	557	525	466	434	388	366
2 1/2"	BTU/hr	9,828,000	6,786,000	5,491,200	4,680,000	4,134,000	3,744,000	3,510,000	3,198,000	3,042,000	2,886,000	2,574,000	2,340,000	2,137,200	1,999,800
	kW	2,878	1,987	1,608	1,371	1,211	1,097	1,028	937	891	845	754	685	626	585
3"	BTU/hr	17,160,000	12,012,000	9,750,000	8,268,000	7,410,000	6,708,000	6,084,000	5,772,000	5,382,000	5,070,000	4,602,000	4,134,000	3,822,000	3,556,800
	kW	5,026	3,518	2,856	2,421	2,170	1,965	1,782	1,690	1,576	1,485	1,348	1,211	1,119	1,042
4"	BTU/hr	35,880,000	24,648,000	19,968,000	17,004,000	15,132,000	13,728,000	12,636,000	11,700,000	11,232,000	10,452,000	9,360,000	8,580,000	7,800,000	7,176,000
	kW	10,508	7,219	5,848	4,980	4,432	4,021	3,701	3,427	3,290	3,061	2,741	2,513	2,284	2,102

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Gas Pipe sizing may be larger than heater connections on installations where a significant run of piping is required. To prevent damage, care must be taken not to apply too much torque when attaching gas supply pipe to gas inlet.

Fittings and unions in the gas line must be metal to metal type.

Apply joint compounds (pipe dope) sparingly and only to the male threads of pipe joints. Do not apply compound to the first two threads. Use compounds resistant to the action of liquefied petroleum gases.

1. CORRECT GAS - Make sure gas on which the boiler will operate is the same as that specified on the rating plate. Do not install the boiler if equipped with a different type of gas. Consult your gas supplier.

2A. SIZING GAS SUPPLY LINE (For single boiler installations). See Table 17.

2B. SIZING GAS SUPPLY LINE (For multiple installations of two or more boilers). See Tables 15 (Natural Gas) and 16 (Propane Gas).

TABLE 17. SINGLE UNIT INSTALLATION, SUGGESTED PIPE SIZE

DISTANCE FROM METER					
BTU INPUT	**0-50'**	**51-100'**	**101-200'**	**201-300'**	**301-500'**
990,000	**2"**	**2"**	**2 1/2"**	**2 1/2"**	**2 1/2"**
1,300,000	**2"**	**2 1/2"**	**2 1/2"**	**3"**	**3"**
1,500,000	**2"**	**2 1/2"**	**3"**	**3"**	**3 1/2"**
1,850,000	**2 1/2"**	**2 1/2"**	**3"**	**3"**	**3 1/2"**
2,100,000	**2 1/2"**	**3"**	**3"**	**3 1/2"**	**4"**
2,500,000	**2 1/2"**	**3"**	**4"**	**4"**	**4 1/2"**

Use Tables 15 or 16, which are taken from ANSI booklet Z223.1, NATIONAL FUEL GAS CODE, or CAN/CSA-B149.1 (current edition) to size iron pipe or equivalent gas supply line.

Where it is necessary to use more than the average number of pipe fittings i.e. elbows, tees, and valves in gas supply line, use a pipe larger than specified to compensate for increased pressure drop.

Gas control trains are unique for each Genesis II unit. Stages one, two and three run sequentially left to right on the smaller units (GB/GW 1000 -1500) while stage one is located in different positions on the larger units. Gas manifold diagrams are depicted in Figure 14.

WIRING CONNECTIONS

ALL ELECTRICAL WORK MUST BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, ANSI/NFPA 70 OR CSA-C22.1 CURRENT EDITION AND MUST CONFORM TO LOCAL REGULATIONS.

AN ELECTRICAL GROUND IS REQUIRED TO REDUCE RISK OF ELECTRIC SHOCK OR POSSIBLE ELECTROCUTION. Make the ground connection to the wire provided in the electrical supply junction box on the boiler.

Grounding and all wiring connected to this boiler must conform to the local code authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code, ANSI/NFPA 70 or CSA-C22.1 current edition.

The Central Control Board and Flame Control Boards that make up the control system are micro-processor based which make them vulnerable to voltage and amperage fluctuations in the power supply. Refer to Connection and Schematic Diagrams. See Figures 15 and 16.

IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR ITS EQUIVALENT.

The Genesis Hot Water Supply Boiler must be connected to a single phase dedicated and isolated line source: **120 volts, 60Hz, and 30 Amps.**

TABLE 18. Orifice Size for Natural and Propane (LP) Gases (U.S. and Canada Installations, for high altitude up to 4,500 ft. (1,372 m).

			Drill Size	
Model	**Input Rating BTU/HR**	**Number of Burners**	**Natural (4 Holes)**	**Propane (3 Holes)**
G(B,W) 1000	990,000	10	0.111"	0.075"
G(B,W) 1300	1,300,000	13	0.111"	0.075"
G(B,W) 1500	1,500,000	15	0.111"	0.075"
G(B,W) 1850	1,850,000	19	0.111"	0.075"
G(B,W) 2100	2,100,000	21	0.111"	0.075"
G(B,W) 2500	2,490,000	25	0.111"	0.075"

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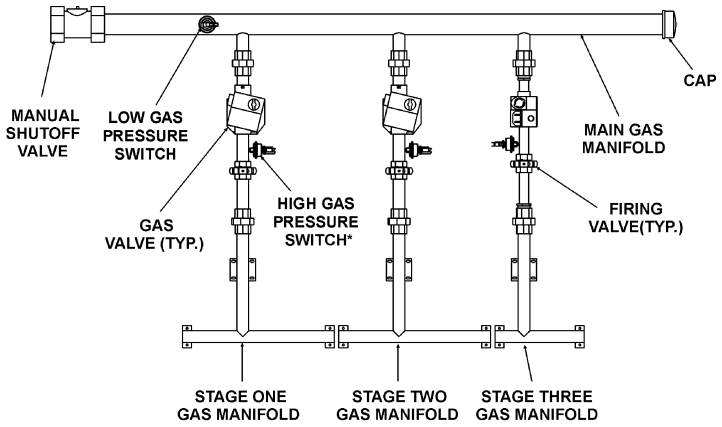
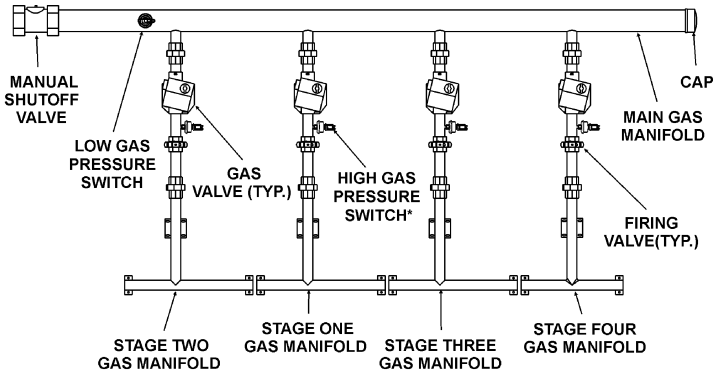
GAS MANIFOLD ASSEMBLY

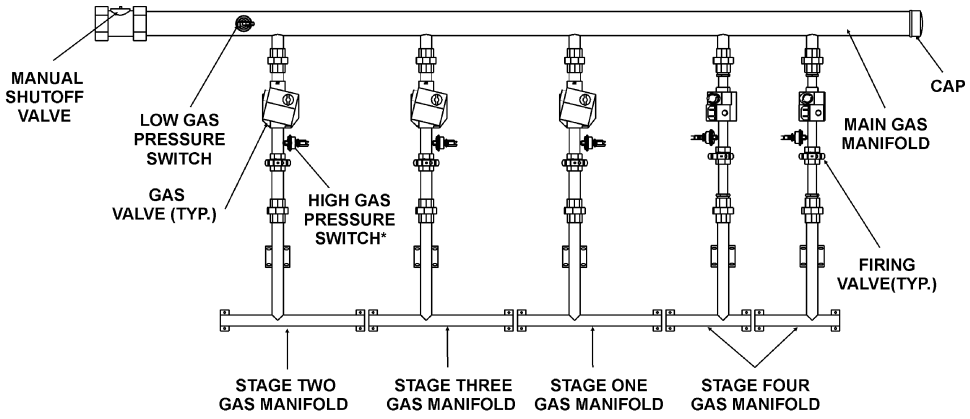
GB/GW 1000 - 1500



GB/GW 1850



GB/GW 2100



GB/GW 2500

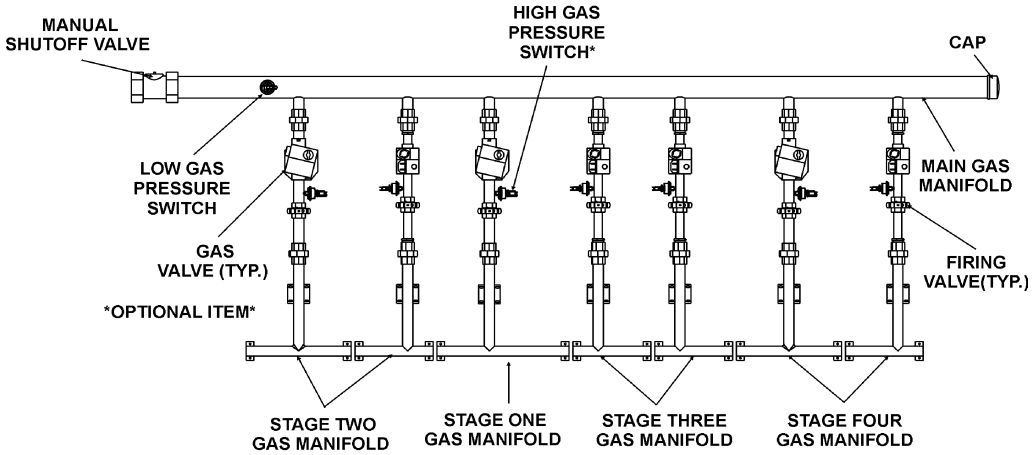


Figure 14. GB/GW 1000 - 2500 Gas Manifold Assembly Diagrams.

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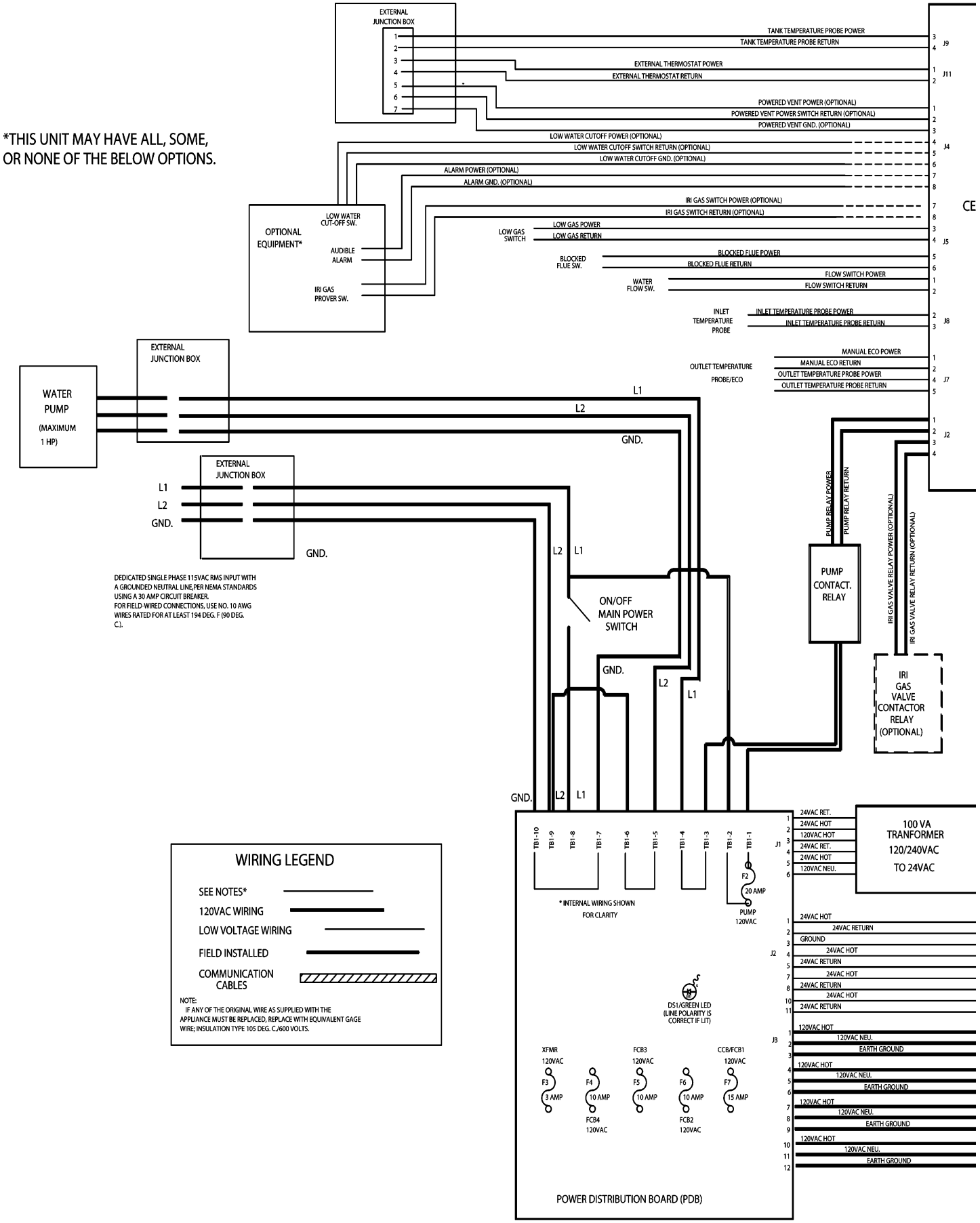
GENESIS GB/GW 1000-2500 SERIES 400 WIRING DIAGRAM

FIGURE 15.



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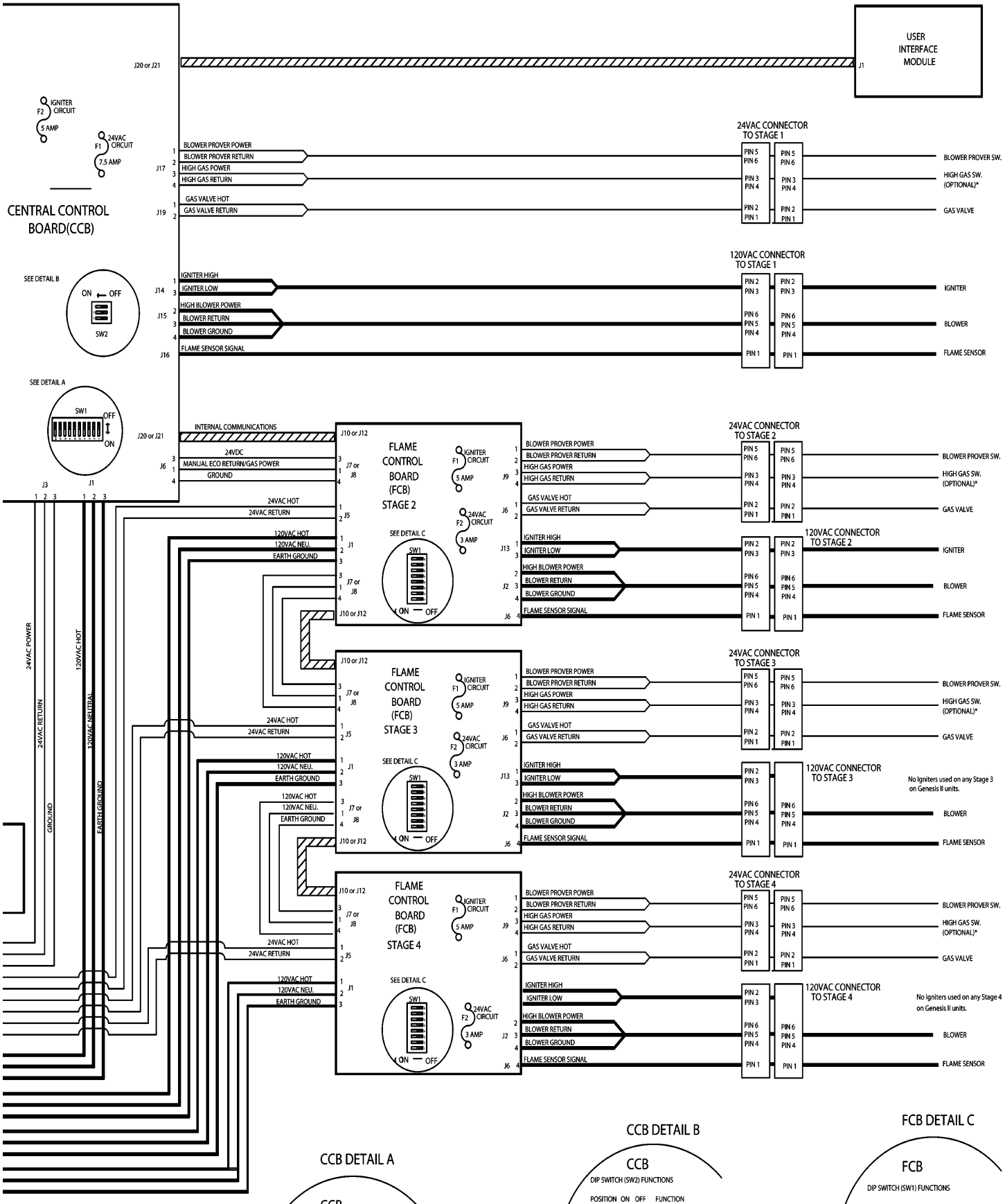

CCB DETAIL A

CCB

DIP SWITCH (SW1) FUNCTIONS

POSITION	ON	OFF	FUNCTION
1	GW	GB	TYPE OF BOILER
2	1	3	IGNITION TRIALS
3	IRI	NO IRI	IRI GAS VALVE
4	INLET	TANK	CONTROLLING PROBE
5	ON	OFF	POWERED VENT
6	ON	OFF	LOW-WATER CUTOFF
7	ON	OFF	LOW GAS SWITCH
8			SPARE
9	SEE TABLE		NUMBER OF STAGES
10	SEE TABLE		1 TO 4

CCB DETAIL B

CCB

DIP SWITCH (SW2) FUNCTIONS

POSITION	ON	OFF	FUNCTION
1			SPARE
2	YES	NO	HIGH GAS SWITCH
3	1	2	BLOWER SPEEDS

FCB DETAIL C

FCB

DIP SWITCH (SW1) FUNCTIONS

POSITION	ON	OFF	FUNCTION
1			SPARE
2	YES	NO	HIGH GAS SW
3	1	2	BLOWER SPEEDS
4	YES	NO	IGNITER
5	YES	NO	BLOWER
6	YES	NO	FLAME SENSE
7	SEE TABLE		BOARD
8	SEE TABLE		ADDRESS

OF STAGES TABLE

SW 9	SW10	# OF STAGES
0	0	1
0	1	2
1	0	3
1	1	4

STAGE ADDRESS TABLE

SW 7	SW8	STAGE #
0	0	NOT ALLOWED
1	0	2
0	1	3
1	1	4

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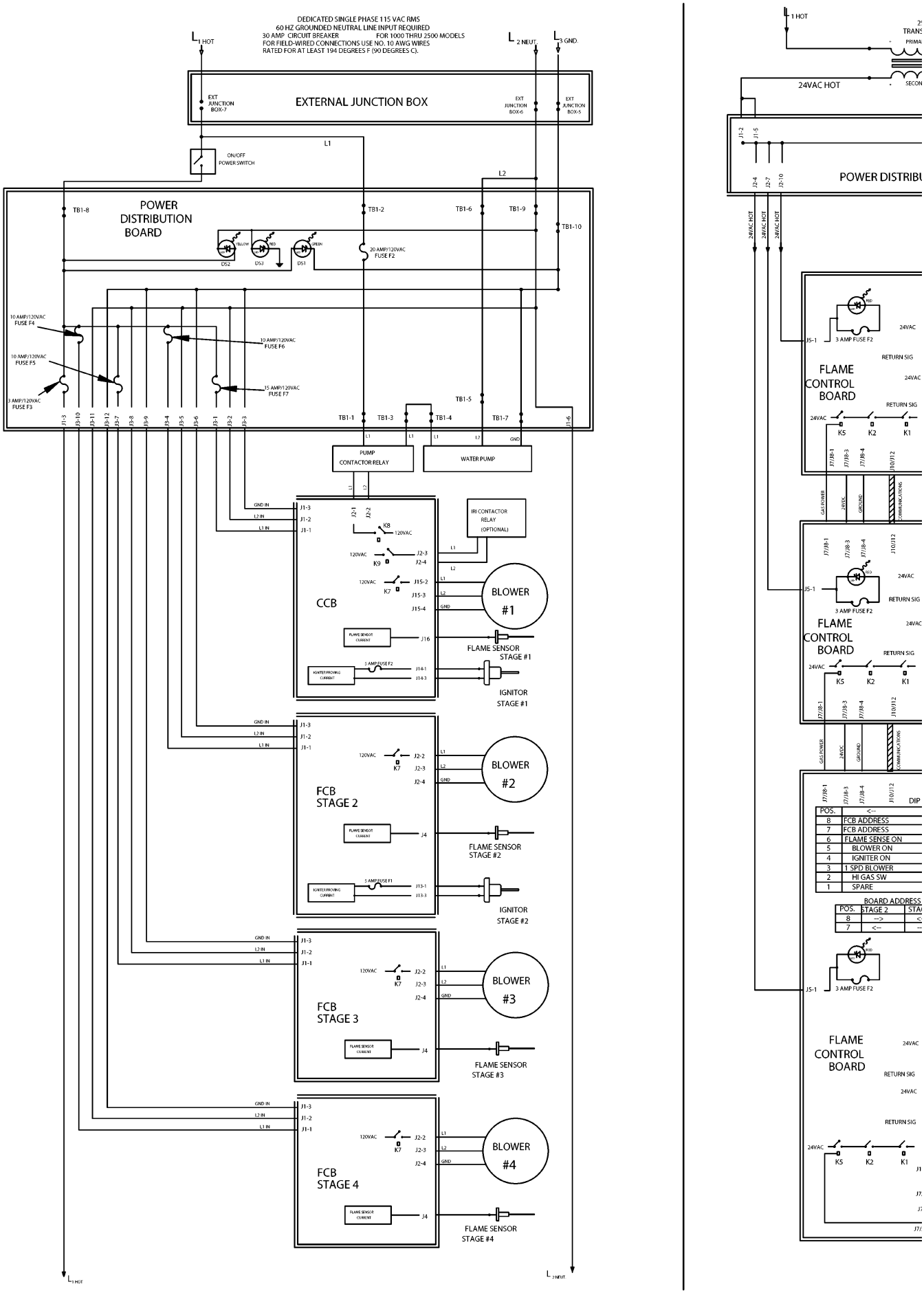
GENESIS GB/GW 1000-2500 SERIES 400 SCHEMATIC DIAGRAM

FIGURE 16.



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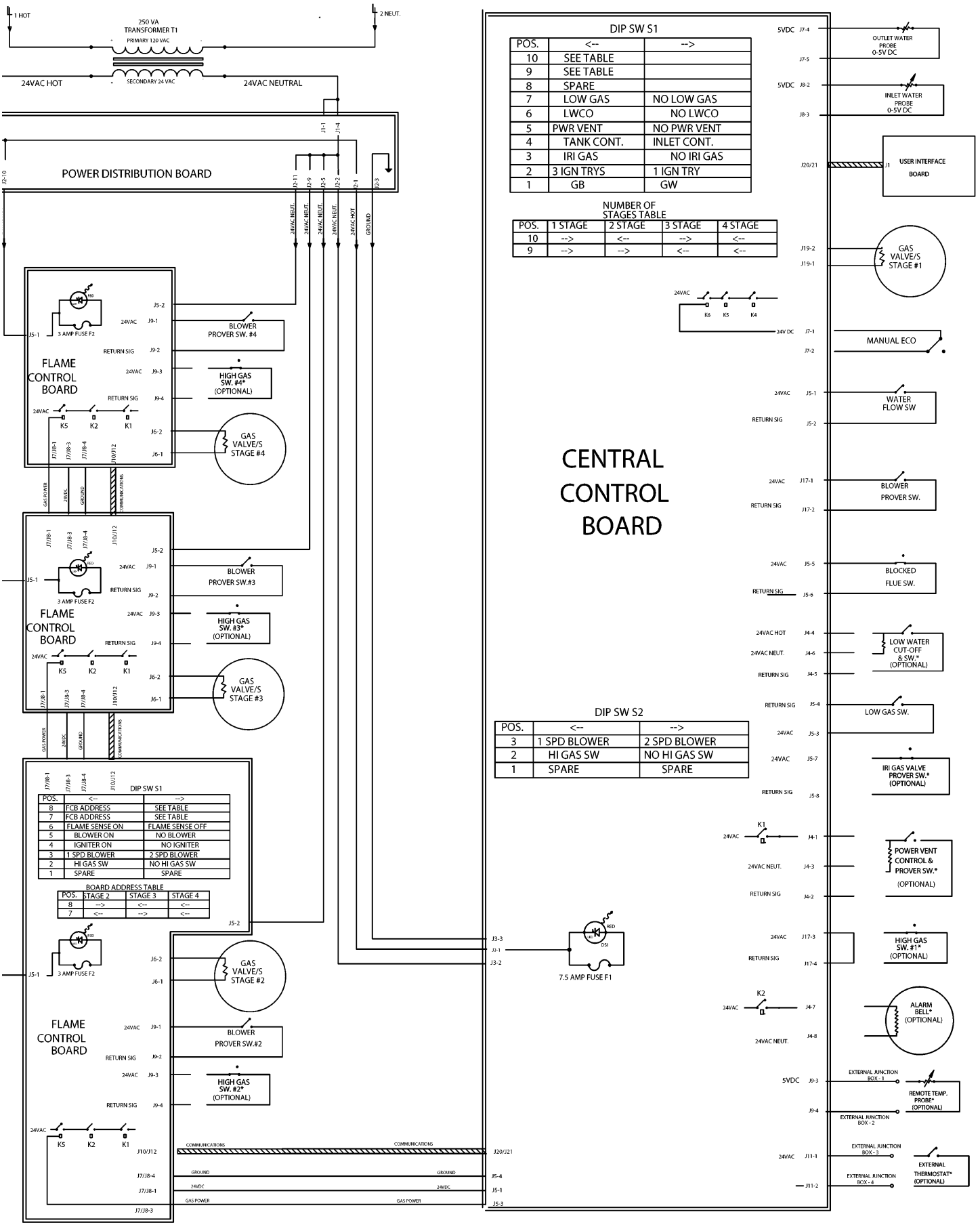
SCHEMATIC DIAGRAM


1 HOT
250 VA TRANSFORMER T1
PRIMARY 120 VAC
SECONDARY 24 VAC
2 NEUT.
24VAC HOT
24VAC NEUTRAL
POWER DISTRIBUTION BOARD
J1-1
J1-4
J2-10
J2-11
J2-9
J2-5
J2-2
J2-1
J2-3
24VAC NEUT.
24VAC NEUT.
24VAC NEUT.
24VAC HOT
GROUND
FLAME CONTROL BOARD
3 AMP FUSE F2
BLOWER PROVER SW. #4
HIGH GAS SW. #4* (OPTIONAL)
GAS VALVE/S STAGE #4
BLOWER PROVER SW.#3
HIGH GAS SW. #3* (OPTIONAL)
GAS VALVE/S STAGE #3
BLOWER PROVER SW.#2
HIGH GAS SW. #2* (OPTIONAL)
GAS VALVE/S STAGE #2
DIP SW S1
POS. | <-- | -->
8 | FCB ADDRESS | SEE TABLE
7 | FCB ADDRESS | SEE TABLE
6 | FLAME SENSE ON | FLAME SENSE OFF
5 | BLOWER ON | NO BLOWER
4 | IGNITER ON | NO IGNITER
3 | 1 SPD BLOWER | 2 SPD BLOWER
2 | HI GAS SW | NO HI GAS SW
1 | SPARE | SPARE
BOARD ADDRESS TABLE
POS. | STAGE 2 | STAGE 3 | STAGE 4
8 | --> | <-- | <--
7 | <-- | --> | <--
CENTRAL CONTROL BOARD
DIP SW S1
POS. | <-- | -->
10 | SEE TABLE |
9 | SEE TABLE |
8 | SPARE |
7 | LOW GAS | NO LOW GAS
6 | LWCO | NO LWCO
5 | PWR VENT | NO PWR VENT
4 | TANK CONT. | INLET CONT.
3 | IRI GAS | NO IRI GAS
2 | 3 IGN TRYS | 1 IGN TRY
1 | GB | GW
NUMBER OF STAGES TABLE
POS. | 1 STAGE | 2 STAGE | 3 STAGE | 4 STAGE
10 | --> | <-- | --> | <--
9 | --> | --> | <-- | <--
DIP SW S2
POS. | <-- | -->
3 | 1 SPD BLOWER | 2 SPD BLOWER
2 | HI GAS SW | NO HI GAS SW
1 | SPARE | SPARE
7.5 AMP FUSE F1
5VDC
OUTLET WATER PROBE 0-5V DC
INLET WATER PROBE 0-5V DC
USER INTERFACE BOARD
GAS VALVE/S STAGE #1
MANUAL ECO
WATER FLOW SW
BLOWER PROVER SW.
BLOCKED FLUE SW.
LOW WATER CUT-OFF & SW.* (OPTIONAL)
LOW GAS SW.
IRI GAS VALVE PROVER SW.* (OPTIONAL)
POWER VENT CONTROL & PROVER SW.* (OPTIONAL)
HIGH GAS SW. #1* (OPTIONAL)
ALARM BELL* (OPTIONAL)
EXTERNAL JUNCTION BOX - 1
EXTERNAL JUNCTION BOX - 2
REMOTE TEMP. PROBE* (OPTIONAL)
EXTERNAL JUNCTION BOX - 3
EXTERNAL JUNCTION BOX - 4
EXTERNAL THERMOSTAT* (OPTIONAL)
COMMUNICATIONS
GROUND
24VDC
GAS POWER

*OPTIONAL INPUTS
THIS UNIT MAY HAVE ALL, SOME, OR NONE OF THE ABOVE OPTIONS.

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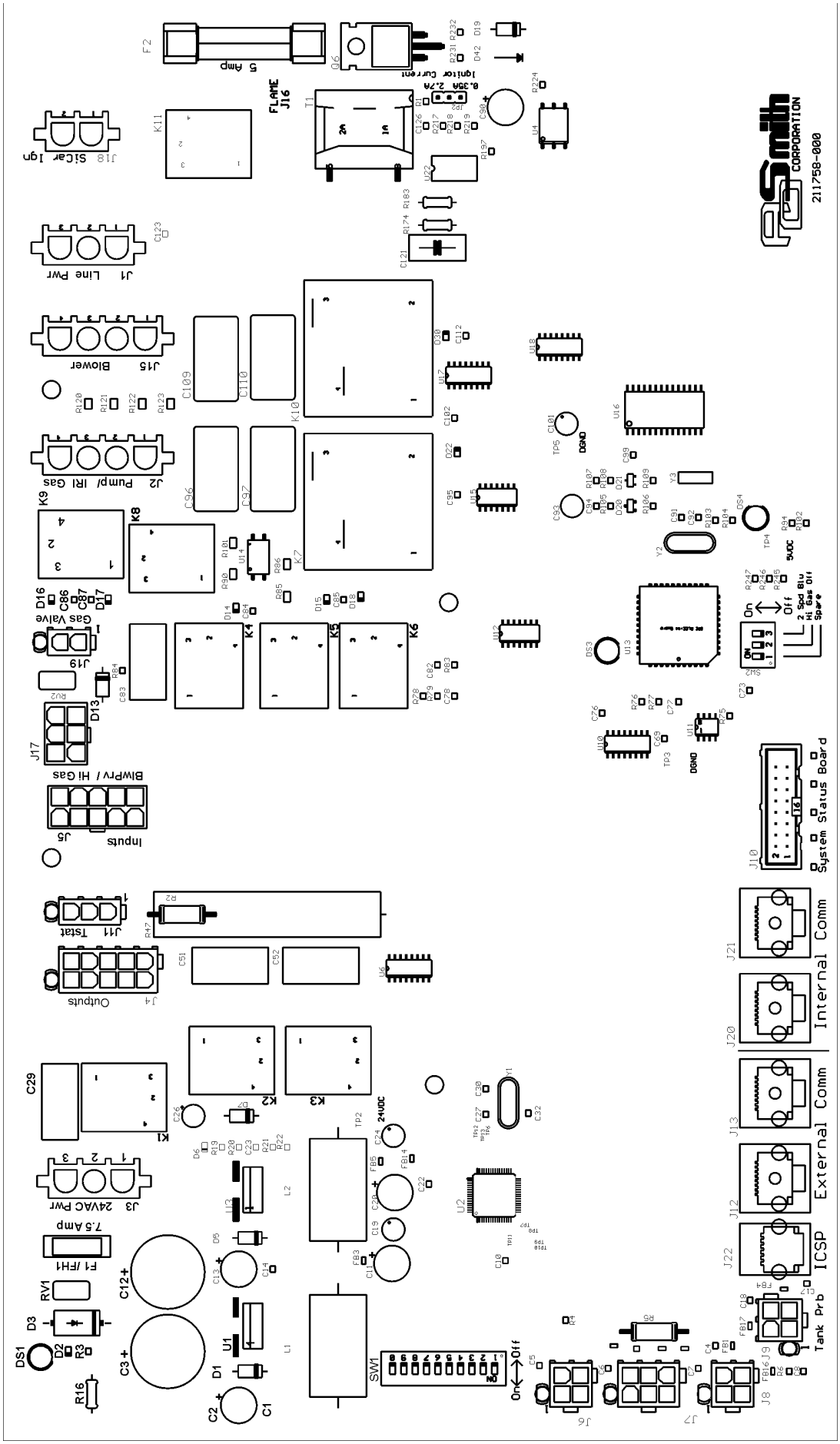

Figure 17. CCB CENTRAL CONTROL BOARD

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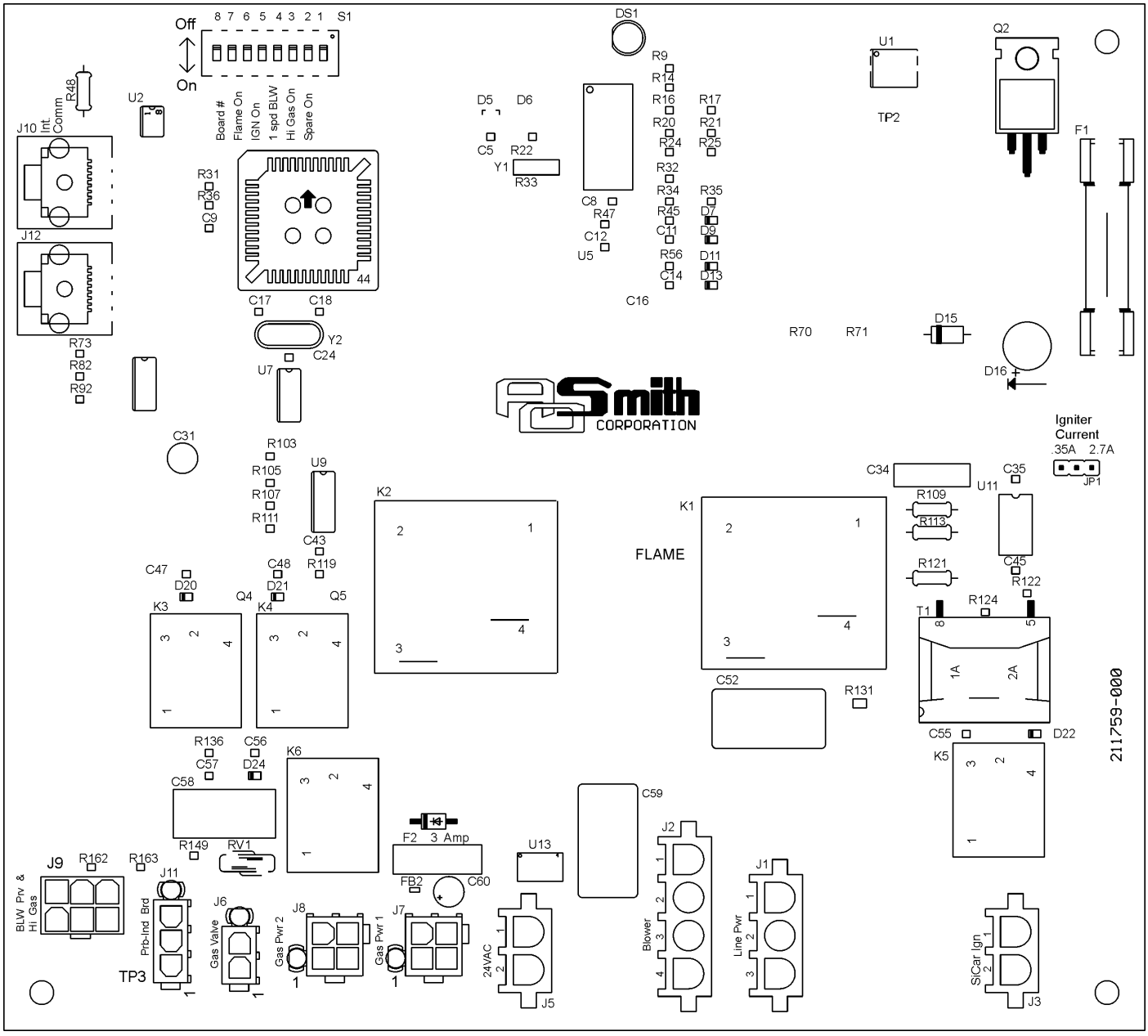

Figure 18. FCB FLAME CONTROL BOARD Diagram

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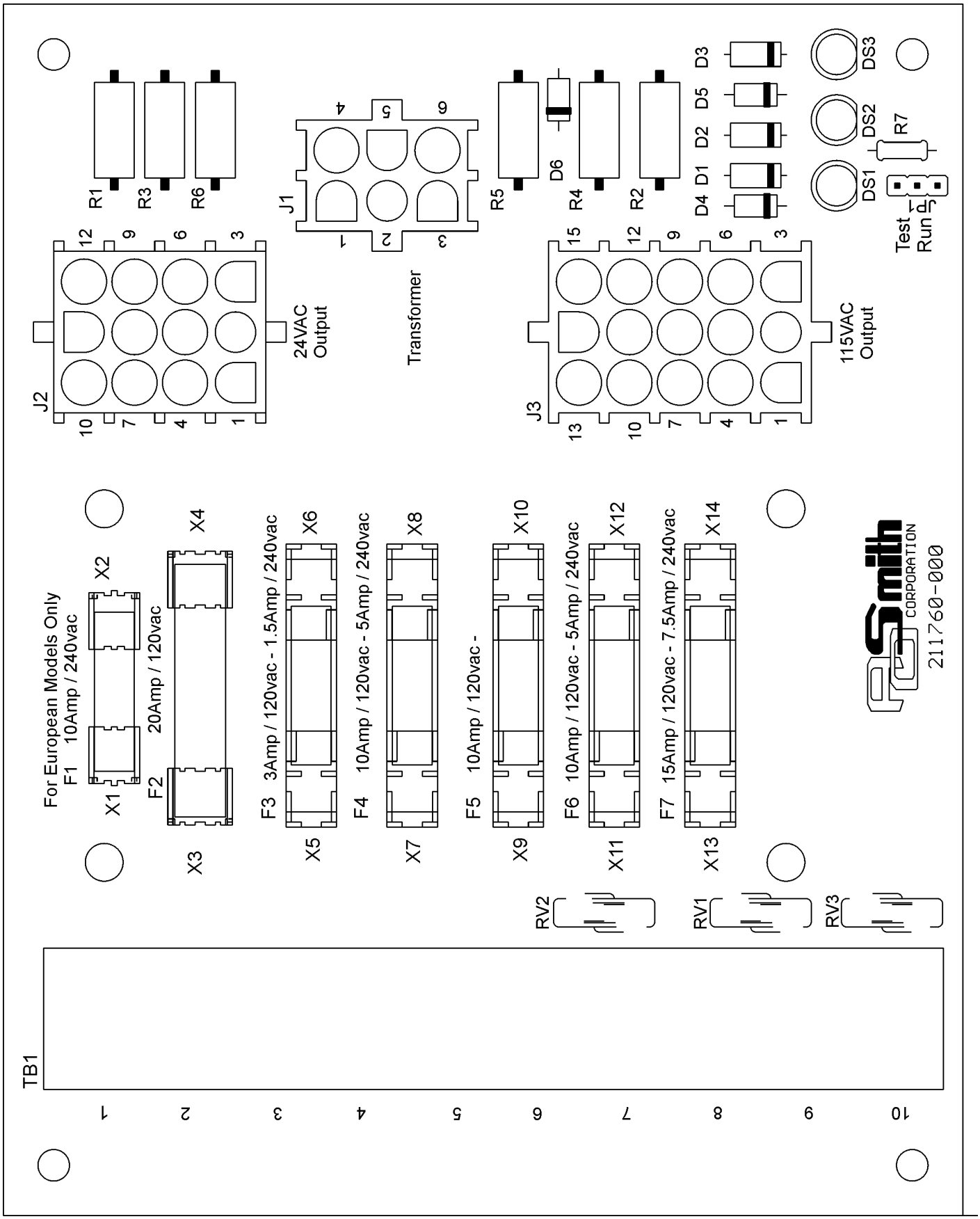

Figure 19. PDB POWER DISTRIBUTION BOARD Diagram

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Fuse Protection

The 24VAC circuitry is protected with a 3 amp fuse on the Flame Control Boards (FCB) and a 7.5 amp fuse on the Central Control Board. If the fuse opens, a red LED located near the fuse will light. See Figures 17 and 18. If the red LED is illuminated, replace the fuse. **Repeated failure of the fuse is an indication of possible damage to the ignition control.** The 120VAC circuits of each Flame Control Board is protected with a 10 amp (15 amp for the CCB) fuse located on the Power Distribution Board (PDB). The 20 amp pump fuse is also on the PDB.

Recommended Replacement fuses:
Littlefuse automotive fuse p/n 29707.5 for the 7.5 amp CCB fuse, and Littlefuse p/n 297003 for the 3 amp FCB fuses.

OPERATION

IMPORTANT

Only qualified personnel shall perform the initial firing of the heater. If you have questions, please contact the factory or your local A.O. Smith representative.

Operation and troubleshooting instructions are included with this manual. By using these instructions, the user may be able to make minor operational adjustments. The user should not attempt repairs, but should contact a service technician or gas supplier for service.

GENERAL

Never operate the boiler without first making sure the boiler and system are filled with water, in addition:

For hot water supply Boiler installations:

- Make sure a temperature and pressure relief valve is installed on the storage tank if used. Also check for leaks.

For heating boiler installations:

- Make sure that the boiler and system have been purged of air and checked for leaks.

FILLING AND PURGING WATER SYSTEM

(A.) Hydronic Heating Installation:

1. Fill system through bypass until pressure approaches desired system pressure. Close bypass valve and permit pressure to be established by the pressure reducing valve.

2. Vent all high points in system to purge system of air.

Provisions should be made to permit manual venting of radiators or convectors.

(B.) Hot Water Supply Installation:

1. Close the systems drain valve.

2. Open a nearby hot water faucet to permit the air in the system to escape.

3. Fully open the cold water inlet pipe valve allowing the heater and piping to be filled.

4. Close the hot water faucet as water starts to flow.

5. The heater is ready to be operated.

PURGING OF GAS LINE

Gas line purging is required with new piping or systems in which air has entered.

CAUTION

PURGING SHOULD BE PERFORMED BY PERSONS EXPERIENCED IN THIS TYPE OF GAS SERVICE TO AVOID RISK OF FIRE OR EXPLOSION. PURGE DISCHARGE MUST NOT ENTER CONFINED AREAS OR SPACES WHERE IGNITION CAN OCCUR. THE AREA MUST BE WELL VENTILATED AND ALL SOURCES OF IGNITION MUST BE DEACTIVATED OR REMOVED.

BEFORE PLACING THE BOILER IN OPERATION, CHECK FOR GAS LEAKAGE. USE A SOAP AND WATER SOLUTION OR OTHER MATERIAL ACCEPTABLE FOR THE PURPOSE OF LOCATING GAS LEAKS. DO NOT USE MATCHES, CANDLES, FLAME OR OTHER SOURCES OF IGNITION FOR THIS PURPOSE.

WARNING

THE GAS VALVE MUST HAVE BEEN IN THE OFF POSITION FOR AT LEAST 5 MINUTES. This waiting period is an important safety step. Its purpose is to permit gas that may have accumulated in the combustion chamber to clear. IF YOU DETECT GAS ODOR AT THE END OF THIS PERIOD DO NOT PROCEED WITH LIGHTING. RECOGNIZE THAT GAS EVEN IF IT SEEMS WEAK, MAY INDICATE PRESENCE OF ACCUMULATED GAS SOMEPLACE IN THE AREA WITH RISK OF FIRE OR EXPLOSION. SEE THE FRONT PAGE FOR STEPS TO BE TAKEN.

INLET GAS PRESSURE

The inlet gas pressure is measured by removing the low gas pressure switch located on the main gas manifold which is upstream of the unit's combination gas valves. See Figure 14. The maximum value specified in the table must not be exceeded. The minimum values, shown in Table 19, must be maintained under both load and no load conditions (static and firing conditions). The combination gas valves supplied with the boiler are for low pressure service. **If upstream pressure exceeds 14.0" W.C., an intermediate gas pressure regulator of the lockup type must be installed.**

TABLE 19. INLET GAS PRESSURES.

INLET GAS PRESSURE	NAT. GAS	PROP. GAS
MAX. INLET PRESSURE (IN. W.C.)	14.0	14.0
MIN. INLET PRESSURE (IN. W.C.)	6.0	11.0

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FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

A. THIS APPLIANCE DOES NOT HAVE A PILOT. IT IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.

B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

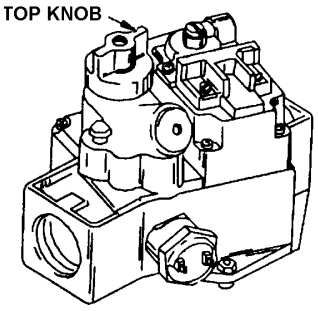
WHAT TO DO IF YOU SMELL GAS

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH; DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

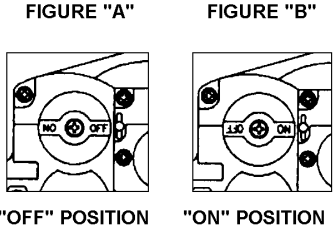
C. USE ONLY YOUR HAND TO PUSH IN OR TURN THE GAS CONTROL KNOB. NEVER USE TOOLS. IF THE KNOB WILL NOT PUSH IN OR TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

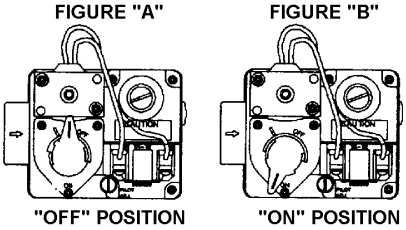
E. DO NOT OPERATE APPLIANCE UNLESS UNIT IS FILLED WITH WATER AND WATER LINES ARE FULLY OPEN.



ROBERTSHAW



WHITE-RODGERS



Note: Knob cannot be turned to "OFF" unless knob is pushed in slightly. Do NOT force.

OPERATING INSTRUCTIONS

1. STOP! READ THE SAFETY INFORMATION THE NEXT STEP ABOVE ON THIS LABEL.
2. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
3. TURN OFF ALL ELECTRIC POWER TO APPLIANCE.
4. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.
5. REMOVE CONTROL ACCESS PANEL.
6. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE ↷ TO "OFF" POSITION, (FIGURE A).
7. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR.

IF YOU SMELL GAS,

STOP ! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DON'T SMELL GAS, GO TO THE NEXT STEP.

8. TURN TOP KNOB OF GAS CONTROL COUNTER CLOCKWISE ↶ TO "ON" POSITION, (FIG. B).
9. REPLACE CONTROL ACCESS PANEL.
10. TURN POWER SWITCH TO "ON" POSITION.
11. SET THE SYSTEM CONTROLLER TO DESIRED SETTING.
12. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS "TO TURN OFF GAS TO THE APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

TO TURN OFF GAS TO APPLIANCE

1. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
2. TURN POWER SWITCH ON APPLIANCE TO "OFF" POSITION.
3. REMOVE ACCESS PANEL TO EXPOSE GAS CONTROL.
4. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE (TO "OFF" POSITION, (FIGURE A).
5. REPLACE CONTROL ACCESS PANEL.

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FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY, A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

A. THIS APPLIANCE DOES NOT HAVE A PILOT. IT IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER. DO NOT TRY TO LIGHT THE BURNER BY HAND.

B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

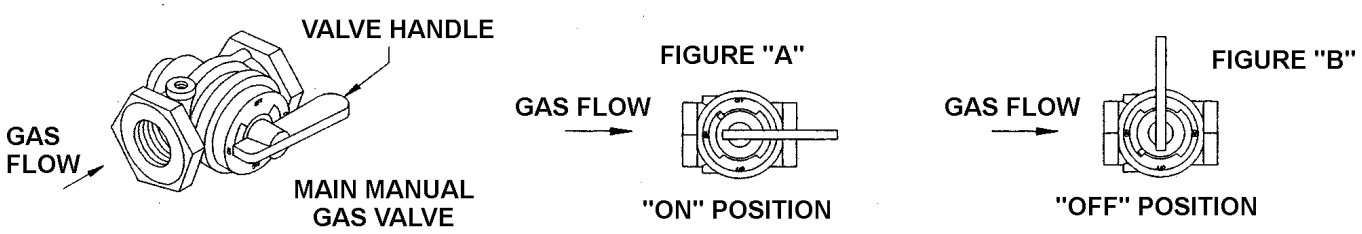
WHAT TO DO IF YOU SMELL GAS

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH.
- DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

C. USE ONLY YOUR HAND TO TURN THE MAIN MANUAL GAS VALVE HANDLE. NEVER USE TOOLS. IF THE HANDLE WILL NOT TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

E. DO NOT OPERATE APPLIANCE UNLESS UNIT IS FILLED WITH WATER AND WATER LINES ARE FULLY OPEN.



OPERATING INSTRUCTIONS

1. STOP! READ THE SAFETY INFORMATION ABOVE ON THIS LABEL.
2. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
3. TURN POWER SWITCH ON APPLIANCE TO "OFF" POSITION.
4. TURN MAIN MANUAL GAS VALVE TO "OFF" POSITION, (FIGURE "B"). THE VALVE IS "OFF" WHEN THE HANDLE IS PERPENDICULAR TO THE GAS FLOW DIRECTION.
5. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE BURNER, DO NOT TRY TO LIGHT THE BURNER BY HAND.
6. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS,

   STOP! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DON'T SMELL GAS, GO TO THE NEXT STEP.
7. TURN MAIN MANUAL GAS VALVE TO "ON" POSITION, (FIGURE "A"), THE VALVE IS "ON" WHEN THE HANDLE IS PARALLEL TO THE GAS FLOW DIRECTION.
8. TURN POWER SWITCH TO "ON" POSITION.
9. SET THE SYSTEM CONTROLLER TO DESIRED SETTING.
10. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS "TO TURN OFF GAS TO THE APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

TO TURN OFF GAS TO APPLIANCE

1. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
2. TURN POWER SWITCH ON APPLIANCE TO "OFF" POSITION.
3. TURN MAIN MANUAL GAS VALVE TO "OFF" POSITION, (FIGURE "B"). THE VALVEIS "OFF" WHEN THE HANDLE IS PERPENDICULAR TO THE GAS FLOW DIRECTION.

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MANIFOLD PRESSURE

The manifold gas pressure is measured at the pressure tap on the downstream side of the combination gas valve(s). For natural gas the Manifold Pressure should measure 3.5" W.C. For propane (LP) gas, the pressure should read 10" W.C.

IMPORTANT

UNDER NO CIRCUMSTANCES SHALL THE GAS PRESSURE MEASURED AT THE BURNER MANIFOLD EXCEED THAT STATED ON THE BOILER RATING PLATE. OVERFIRING WILL RESULT IN DAMAGE TO THE BOILER, AS WELL AS INCREASED RISK OF FIRE, SOOTING AND ASPHYXIATION.

ADJUSTMENTS

ON INITIAL STARTUP SOME ADJUSTMENTS ARE NECESSARY.

1. CHECK MANIFOLD AND INLET GAS PRESSURES.

2. CHECK THE INPUT. SEE NATIONAL FUEL GAS CODE, ANSI Z223.1 OR CAN/CSA - B149.1 (CURRENT EDITION) FOR PROCEDURES.

⚠ DANGER

HOT WATER TEMPERATURES REQUIRED FOR AUTOMATIC DISHWASHER AND LAUNDRY USE CAN CAUSE SCALD BURNS RESULTING IN SERIOUS PERSONAL INJURY AND/OR DEATH. THE TEMPERATURE AT WHICH INJURY OCCURS VARIES WITH THE PERSON'S AGE AND TIME OF EXPOSURE. THE SLOWER RESPONSE TIME OF CHILDREN, AGED OR DISABLED PERSONS INCREASES THE HAZARDS TO THEM. NEVER ALLOW SMALL CHILDREN TO USE A HOT WATER TAP, OR TO DRAW THEIR OWN BATH WATER. NEVER LEAVE A CHILD OR DISABLED PERSON UNATTENDED IN A BATHTUB OR SHOWER.

THE WATER HEATER SHOULD BE LOCATED IN AN AREA WHERE THE GENERAL PUBLIC DOES NOT HAVE ACCESS TO SET TEMPERATURES.

IT IS RECOMMENDED IN DOMESTIC HOT WATER APPLICATIONS THAT LOWER WATER TEMPERATURES BE USED TO AVOID THE RISK OF SCALDING. IT IS FURTHER RECOMMENDED, IN ALL CASES, THAT THE WATER TEMPERATURE BE SET FOR THE LOWEST TEMPERATURE WHICH SATISFIES THE USER'S HOT WATER NEEDS. THIS WILL ALSO PROVIDE THE MOST ENERGY EFFICIENT OPERATION OF THE BOILER AND MINIMIZE SCALE FORMATION IN THE HEAT EXCHANGER, THUS PROLONGING THE LIFE OF THE BOILER.

SETTING THE WATER HEATER TEMPERATURE AT 120°F (49°C) WILL REDUCE THE RISK OF SCALDS. SOME STATES REQUIRE SETTINGS AT SPECIFIC LOWER TEMPERATURES. TABLE 20 ABOVE SHOWS THE APPROXIMATE TIME-TO-BURN RELATIONSHIP FOR NORMAL ADULT SKIN.

TABLE 20. RISK OF SCALDS.

TEMPERATURE SETTING	TIME TO PRODUCE 2nd & 3rd DEGREE BURNS ON ADULT SKIN
OVER 170°F (77°C)	NEARLY INSTANTANEOUS
160°F (71°C)	ABOUT 1/2 SECOND
150°F (66°C)	ABOUT 1-1/2 SECONDS
140°F (60°C)	LESS THAN 5 SECONDS
130°F (54°C)	ABOUT 30 SECONDS
120°F (49°C) OR LESS	MORE THAN 5 MINUTES

USE ANTI-SCALD VALVE(S) in the hot water system to reduce the risks of scalding at points of use such as lavatories, sinks and bathing facilities.

CONTROL SYSTEM

The EMC 5000 control system is a fully integrated, state of the art electronic control system. It consists of sensors, output devices, a power switch, a 24vac transformer, wiring and the following printed circuit boards:

- Central Control Board (CCB), see Figure 17.
- Flame Control Board (FCB), see Figure 18.
- Power Distribution Board (PDB), see Figure19.
- User Interface Module (UIM), see Figure 21.

The CCB contains circuitry for both master control and flame control for the first stage. The FCB's contains circuitry for control on up to three additional stages. Dipswitches on the CCB and FCB are used to configure the system. The User Interface Module (UIM) communicates with the user through a set of touch pads and a 4-line, 20-character LCD display. The PDB provides connection points for input power, the water pump, and the transformer. It also distributes power to the system and contains the system fuses.

Multiple-stage control is accomplished by means of an internal communications network between the CCB and the FCB's. One FCB is required for each stage beyond the initial first stage. The CCB also contains an external communications system to allow for connection to a PC, a modem, an EMS system, or something similar. Through this connection multiple boilers can also be linked together. **CAUTION: The internal communications cables should never be connected to the external communications connectors and vice-versa.**

There are several microcontrollers used on the boards. These micros control the temperature and ignition control functions for the boiler. Inherent in the design are the normal operating sequences and safety features associated with a gas ignition control system. The system continuously performs various diagnostic tests to verify proper appliance and control operation. Should an unsafe condition occur, the control will shut down the burner and display a red fault light as well as indicate the cause of the fault on the display. The operating programs for the system are stored in permanent memory inside the micros. User-selectable operating parameters and a history of detected faults are stored in re-writable memory in the micros. A loss of power does not affect either of the memories.

Inputs to CCB and FCB
Temperature Sensors:

- Temperature probes (CCB - outlet and either inlet or tank are

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required): The CCB accepts analog temperature inputs from up to three sensors (inlet, outlet and tank).

- ECO input (CCB - required):
  The ECO (energy cut off) is a hi-limit switch, which is located inside the outlet probe. It is a normally closed switch that opens if the probe is exposed to a temperature higher than the trip point. Once tripped, control system needs manual reset.
- Thermostat input (CCB - optional):
  This input is set up to work with an externally connected thermostat that provides a contact closure. If this input is closed and everything else is in the proper state, a "call for heat" condition will be initiated. These leads should be shorted together, when a thermostat is not being used. If it is desired that the thermostat control the temperature of the boiler, the operating setpoint of the system should be set higher than the temperature that the thermostat is controlling to. This will allow the thermostat to control the boiler. When the thermostat closes, a call for heat will be generated until the thermostat determines that the required temperature has been reached.

Air Pressure Sensors (open condition indicates fault):

- Blocked Flue (CCB - required):
  Normally closed switch that opens if the flue becomes blocked during operation.
- Powered Vent (CCB - optional):
  Normally open switch that closes when the powered vent is operating properly. This input is enabled/disabled by a dipswitch on the CCB.
- Blower Prover (CCB/FCB - required on Stages with Blowers).
  Normally open switch that closes when the air pressure produced by the blower is above the set point.

Gas Pressure Sensors (open condition indicates fault):

- Low Gas (CCB - required):
  Normally open switch that closes when the gas pressure rises above the trip level. This input is enabled/disabled by a dipswitch on the CCB.
- Hi Gas (FCB - optional):
  Normally closed switch that opens if the gas pressure exceeds a set value. This input is enabled/disabled by a dipswitch on the CCB and FCB's.

Water Level Sensor (open condition indicates fault):

- Low Water Cut Off (CCB - optional):
  Normally open switch that closes when water reaches preset level. This input is enabled-disabled by a dipswitch on the CCB.

Water Flow Sensor:

- Flow (CCB - required):
  Normally open switch that closes when flow exceeds a set value.

IRI Gas Valve Sensor:

- IRI Gas Valve (CCB - optional):
  Normally open switch that closes when the IRI Gas Valve is operating correctly. This input is enabled/disabled by a dipswitch on the CCB.

- **Flame Sensor:**

  Flame (CCB - required).
  Returns a signal to the microprocessor if flame is detected on the burner. If the flame rod is missing or shorted, the flame will not be detected. This input is enabled/disabled by a dipswitch on the FCB.

Outputs from CCB and FCB's:

Relay Contact Output:

- IRI Gas Valve (CCB - 120 vac - optional):
  Provides electrical power to operate an IRI Gas Valve Device.
- Alarm (CCB - 24vac - optional):
  Provides electrical power to operate an external alarm. This can be an audio device (i.e. Sonalert), a visual device (lamp), or any other device that will operate with the voltage and current level provided.
- Pump (CCB - 120vac - required on systems that do not have an external pump):
  Provides electrical power to directly operate a pump or the coil of an externally connected contactor.
- Powered Vent (CCB - 24 vac - optional):
  Provides electrical power to operate a powered vent.
- Blower (CCB / FCB - 120vac - required).
  Single speed blowers utilize the high blower output only. Dip switches on the FCB's enable/disable the use of blowers on stages 2, 3 and 4.
- Igniter (FCB - 120vac - required).
  Provides power to operate the HSI igniters. Dip switches on the FCB's enables/disables the use of HSI igniters on stages 2, 3 and 4.
- Gas Valve (FCB - 24vac - required):
  Provides power to activate the gas valve. The gas valve cannot be activated when the ECO contacts are open.
- Low Water Cut Off (CCB - 24vac - optional)
  Directly connected to the 24 vac line to provide power to operate an external LWCO device.

CCB/FCB Indicator Lamps & Fuses

A green LED is mounted on the PDB to indicate when line voltage is applied. (The PDB also contain a yellow and red LED, and a test/run jumper, that are used during installation to verify proper power connections.) A red LED on the CCB is used to indicate when the 24vac input fuse has blown. The FCB's also have fuses on their 24vac power line.

Yellow LED's are located near the micros on the CCB and FCB's. These LED's are "heartbeat indicators" and blink approximately twice per second to indicate that the micros are running.

CCB/FCB Jumpers:

The CCB has two jumpers and the FCB has one. JP1 on the CCB is used to terminate the external communications line. It is normally left off and installed when the external cable is very long. JP2 on the CCB and JP1 on the FCB, are for factory use only.

Igniters

The EMC 5000 system operates with Silicon Carbide Igniters.

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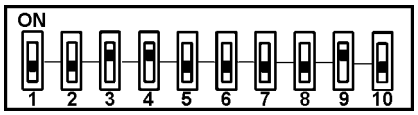
CCB - Ten Position Dipswitch (Central Control Section) SW1:

Dipswitch configurations are READ ONLY ON POWER UP. These switches are only to be set at the factory or by authorized trained personnel! Once set the boiler will operate according to the chosen options. If a switch is changed, power must be cycled before the change will take effect. The status of all dipswitches can be observed on the system status screen on the UIM.

CCB/FCB Dipswitches:

Dipswitches Function	Switch Position	
	Boilers	Water Heaters
Switch 1: Selection of the type of boiler application:	On = GB/LB	Off = GW/LW
Switch 2: Trials for ignition:	On = 3	Off = 1
Switch 3: IRI Gas Valve Option:	On = IRI	Off = No IRI
Switch 4: Controlling Probe:	On = Tank (Remote)	Off = Inlet
Switch 5: Powered Venter:	On = Yes	Off = No
Switch 6: Low Water Cut Off: (LWCO)	On = Yes	Off = No
Switch 7: Low Gas Pressure	On = Yes	Off = No
Switch 8: Spare:		
Switch 9 & 10. Number stages (FCB's):	9 10	#stages
	Off Off	= 1
	Off On	= 2
	On Off	= 3
	On On	= 4

NOTE: If the unit powers up with the number of stages selected by dip switches exceeding the number of FCBs, the CCB will detect this condition and go into a hard lockout. **After changing the dipswitches to the correct number of stages, the power must be cycled on and off to accept the change.**



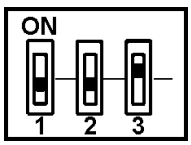
Example of Dipswitch configuration:
GW model, 1 ignition trial, IRI, Tank Probe used, No Power Vent, No LWCO, No Low Gas, 3 stages.

CCB - Three position Dipswitch (Flame Control Section) SW2:

This dipswitch is similar to the FCB dipswitches described below, but with only three switches being used: the number of blower speeds (switch #3), Hi Gas option (switch #2) and a spare (switch #1). Only the blower speed and Hi Gas options are the required selection, within the CCB . The FCB1 always has a blower, igniter, flame checking, and the address is always stage 1, see Figure 16.

Dipswitch Function:	Dipswitch Position	
Switch 1: Spare:		
Switch 2: Hi Gas pressure switch:	On = Yes	Off = No
Switch 3: Number of Blower Speeds:	On = 1 speed,	Off = 2 speed

CCB-SW2



Example of Dipswitch configuration:
No High Gas, 1 blower speed.

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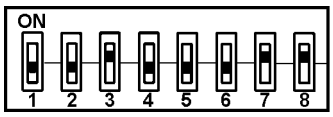
FCB: Eight-Position Dipswitch

The first three switches are similar to the switch setup of SW2 on the CCB. The remaining five switches are required for the function of igniter, blower, flame detection, and to address the firing stage. NOTE: When switch 5 is set to OFF (no blower), switch 3 (blower speed) is ignored.

Dipswitch Function:	Dipswitch Position	
Switch 1: Spare:		
Switch 2: Hi Gas pressure switch:	On = Yes	Off = No
Switch 3: Number of Blower Speeds:	On = 1 speed,	Off = 2 speed
Switch 4: Igniter used:	On = Yes,	Off = No
Switch 5: Blower used:	On = Yes,	Off = No
Switch 6: Flame Checked:	On = Yes,	Off = No
Switch 7 & 8. Stage selection:	7 8	Stage #
	Off Off	Not allowed
	On Off	2
	Off On	3
	On On	4

*When switch 5 is in off (no blower) position, switch 3 (blower speeds) is ignored.



Example of Dipswitch configuration:
No High Gas, 1 blower speed, no igniter, no blower, flame not checked, stage 4.

Operating Sequence

NOTE: The following sequence is based on a three-stage system.

1. The EMC 5000 controller has four modes of operation: Initialization, Standby, Running, and Service. The internal CCB and FCB micros control these modes through a sequence of steps (or States) which are further described in the "UIM Operating Procedures" section.

2. When power is applied to the system, it enters the initialization mode and the following automatic functions are performed:
   - A. O. Smith opening screen is displayed.
   - The system goes through a calibration indicated by the green running LED blinking and then staying on; next the red service LED and yellow standby LEDs come on, next the stage 1 service and runnings LEDs blink ON and OFF followed by stage 2, stage 3, stage 4 and then back to stage 1, 2, 3, 4 LEDs.
   - Stored values are recalled from memory.
   - Configuration dipswitches are read.
   - Pending faults are recalled
   - Micros on all boards start running (indicated by a flashing Yellow LED near each micro)
   - Input sensors are read
   - FCB's are configurated with the number of ignition trials to run.

3. After initialization is complete (approximately 10 seconds) the system turns the green LED off and goes to the standby mode (yellow "Standby" LED on), unless a previously stored fault has been recalled, which will send the system into the service model (red "Service" LED on). In standby mode the display shows the temperature screen and in fault mode the current error screen is displayed.

4. The system then compares the temperature read from the controlling probe (inlet or tank) to the setpoint temperature. If the temperature is less than the operating setpoint minus the differential temperature and the thermostat input is closed then a call for heat is established and the system shifts to the run mode (green "Running" LED turns on).

5. The heating sequence begins by applying power to the pump and, if selected, the powered vent and the IRI gas valve.

6. After a few seconds the blowers are turned on for 30-second pre-purge period of combustion chamber.

7. The stage one igniter is turned on.

8. After the igniter has reached a minimum of 2.8 amps, the gas valve is energized to allow gas flow to burners.

9. After an additional one second, the system checks the status of the flame through the flame rod (sensor). If the flame is not verified within 4 seconds, the gas valve is immediately shut off

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followed by 15-second inter-purge period, then the system returns to step 7, if the "Trial for Ignition" dipswitch is set for three (3) tries. If the dipswitch is set for one (1) trial, the system will declare an error and boiler will require resetting the control.

10. If a flame is detected, stage two will be activated and start its blower. Once the blower air has been proven, igniter two will begin trial for ignition cycle as above, (this is not the case for model 1000, which has only one igniter).

11. Stage three will activate upon flame detection on stage two. The gas valve will open five seconds following call for heat and gas flow will continue if flame signal is detected. (On 4-stage firing system, the blower associated with stage three will start and once the blower air has been proven, the ignition cycle will take place as above. If flame is not proven, a 15-second inter-purge period will be activated followed by another trial for ignition).

12. All stages will remain running until the set point for a given stage is satisfied. The last stage will drop out first followed by inter-stages then stage one will drop out last. Note: Once a stage is satisfied, the blower associated with that stage will continue for 15-second post purge period.

13. Once all the stages have been satisfied, the boiler pump will continue to run for the programmed post-circulate cycle.

14. The control now enters the idle state as displayed by the "Standby" LED. The control will continue to monitor heat demand and state of other system devices. Upon a drop of water temperature below the set parameters, the control will return to step 5 and repeat the entire operating cycle. Note: Any fault detection, during standby or running modes, will halt the heating sequence and shift the system to the service mode where the detected fault will be displayed.

NOTE: In standby and running modes the system constantly monitors the signals and the internal operation for faults. Any detected fault will halt the heating sequence and shift the system to the service mode, where the detected fault will be displayed.

Temperature Setpoints (System Control Algorithm)

The boiler has a hysteresis type control, which means that it will begin heating the water when the temperature sensed by the control probe (inlet or tank) falls below the operating setpoint minus the differential setpoint for stage 1. It will stop heating the water when the temperature rises to the operating setpoint. If the system has multiple stages then the differential setpoint for each stage is also subtracted from the operating setpoint. The following examples will further explain this operation.

Setup: 2 stage system, operating setpoint - 140, stage 1 to 2 differential setpoints = 10.

Example 1. Temperature begins at 150 and drops to 90, see Figure 20A. At 140 the system remains in idle mode. As the temp drops to 130 (140-10) stage 1 turns on and stage 2 remains off. At 120 stage 2 also turns on.

Example 2. Temperature begins at 90 and rises to 150, see Figure 20B. At 100 both stages are on. (This is the case when a boiler is first started and the controlling temperature is below the operating setpoint minus all of the differential setpoints. At that time both stages are turned on, in sequence from 1 to 2. At 130 stage 2 turns off. At 140 both stages are off.

Stages 1 and 2 will turn on in sequence from 1 to 2.

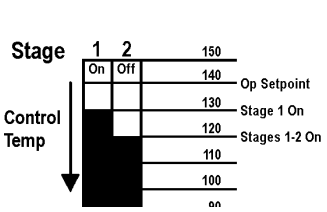

FIGURE 20 A.

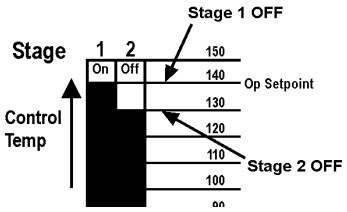

FIGURE 20 B.

UIM OPERATING PROCEDURES

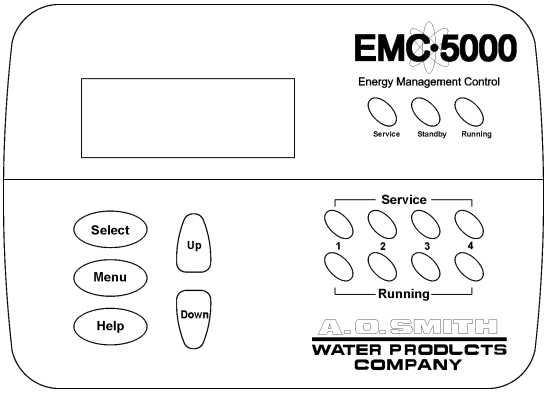

FIGURE 21. UIM, USER INTERFACE MODULE

The UIM receives commands from the user and displays operational information to the user via an LCD (liquid crystal display) up to eleven LED's, and five touch switches. The LCD provides information to the user by the use of 10 menu-activated screens. Within each of the screens, helpful information can be displayed by pressing the "Help" button. The LED's visually inform the user about the mode the system is in. The touch switches allow the user to control the operation of the system. The operation of these parts is described in the following section:

UIM Screens:

On all screens a double vertical bar appears on the right side of the display each time a key is touched to indicate that a key has been activated. On several screens an indicator ">" appears on the left side of the display to indicate the active line. The "Up/Down" keys are used to move the indicator to the desired line and the "Select" key is pressed to select the line. Also, on most of the screens, up/down arrows appear on the right side of the screen to indicate that there is additional lines either above or below the displayed four lines.

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The following status information is displayed from the **System Status Screen**:			
Status Displayed	***(True Condition)**	**Input**	**Output**
ECO	Outlet temperature too high	open	- - - -
LW/CO	Water Level low	open	- - - -
Blk Flue	Flue blocked	open	- - - -
Flow	Water flowing	closed	- - - -
Low Gas	Gas pressure low	open	- - - -
Tstat	Thermostat requesting heat	closed	- - - -
Hi Limit	Outlet temp exceeds High Limit setpoint	- - - -	- - - -
Pump	Pump output activated	- - - -	On
IRI Gas Pwr	IRI output relay activated	- - - -	On
IRI Gas	IRI Gas Valve on	closed	- - - -
Pwr Vent	Power Vent running	closed	- - - -
Alarm	Alarm output activated	- - - -	On
Pwr Vent Pwr	Power Vent output relay activated	- - - -	On
	- - - - STAGES 1 to 2 - - - -		
BlwHi Prv	Blower pressure sufficient	closed	- - - -
Blw Hi	Blower High output activated	- - - -	On
BlwLo Prv	Blower pressure sufficient (not used at this time)	closed	- - - -
Blw Lo	Blower low output activated (not used at this time)	- - - -	On
Ignt Cur	Igniter current sufficient for ignition	- - - -	- - - -
Ignit	Igniter output is activated	- - - -	On
Gas Relay	Gas output relay activated	- - - -	On
Hi Gas	Gas pressure too high	open	- - - -
Flame	Flame detected	- - - -	- - - -

- **Menu Screen:**
  Displayed when the user presses the "Menu" key. This screen is the selection point for the other 9 screens.

- **Temperature Screen:**
  Displays the sensed temperatures of the Outlet, Inlet, and Tank probes. Also displayed is the calculated Delta T (Outlet minus Inlet) for the system. Shorted ("Short") and disconnected ("----") probes are also displayed.

- **System Status Screen:**
  This screen is used to view the status of switch inputs and output states. An asterisk (*) is displayed next to the label when the status is "True" (the description is fulfilled). For example, if water is flowing, or detected by the flow sensor, then an "*" will appear in front of the Flow label (i.e. *Flow). Another example would be the ECO switch. If the outlet temperature is too high the display will show: *ECO.

NOTE: The LWCO, IRI Gas Valve, Powered Vent, High Gas, and Low Gas inputs are optional inputs. Flame sensing, Igniters, and Blowers are optional on Stages 2, 3 and 4. (Except on a 4-stage system, stage 2 always has an Igniter, Blower, and Flame Sensor. Those dipswitches on stage 2 are not relevant.) One or two speed blowers can be used on any stage.

The System monitors the inputs at these times:

- ECO, LWCO, Blocked Flue, Low Gas, Hi Limit, and Hi Gas - at all times for a fault condition.
- Tstat - at all times for open/closed conditions.
- IRI Gas and Powered Vent - for an on condition when their outputs (Pump, IRI Gas Pwr, Powered Vent Power) are turned on and an off condition at all other times.
- Flow - for an on condition when the pump is on (no check for off state)
- Blower Prover - when the Blower is on.
- Igniter Current - for an on condition approximately 18 seconds after the Igniter is turned on until the igniter is turned off and an off condition at all other times.
- Flame - for an on condition approximately 5 seconds after the gas valve is turned on until the valve is turned off and at all other times for an off condition.

Control Status Screen:
Displays the status that the CCB and FCB micros are in. The CCB has 5 possible states and the FCB's have 9. The normal CCB states sequence is to move from Idle, to Pre-Circulate, then to Heating Stage 1-2-3-4 when a call for heat is initiated. Once heat has been satisfied or the Thermostat is opened, the sequence moves to Post-Circulate and then back to Idle. If a fault occurs at any time, the process jumps out of sequence and goes directly to the appropriate Hard or Soft Fault state.

Description of CCB control states:
- Idle:
  The yellow "Standby" LED is turned on and the system waits for a heat request (determined by the Thermostat or controlling probe inputs). All outputs are off in this state except that if the Post-Circulate time is set to continuous, the pump will be on. When the heat request is received, the system moves to the Pre-Circulate state.
- Pre-Circulate:
  The yellow LED is turned off and the green "Running" LED is turned on. The green LED will remain on for all other states except the fault states. If enabled the powered vent and the IRI gas valve are turned on. A command is sent to all active stages to cold purge the system. Cold purging clears out any combustion gas that may be in the combustion chamber. When purging is complete the system moves to the Heat State.
- Heat Stages 1-2-3-4:
  The system will command the FCB micros to start their heat sequence starting with stage 1. Stage 2, 3, 4 will be activated in order based on an algorithm that determines how much heat is needed. The system will remain in this state until the heat request is satisfied, the Tstat is opened, or a fault occurs.

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- Soft Fault State: (See "Fault Description" section for list of soft and Auto Reset faults.)

  The CCB turns off the Powered Vent and the IRI Gas. The pump remains on for the selected post-circulate time to cycle the hot water out of the boiler. The FCB's are commanded to shut down and the Alarm output is turned on. The green LED turns off and the red "Service" turns on. The CCB remains in this state until one of the following occurs:

  - One hour passes (automatic restart after one hour)
  - If Communications error system will automatically restart if communications re-establishes.
  - If user presses Select key while current error screen is displayed (Hard reset).
  - If high-limit error - the outlet temperature drops below the high limit trip point minus the high limit differential. (outlet water temperature drops to safe level). The fault is logged in the error history when the fault state is exited.
  - Hard Fault State: (See "Fault Description" section for list of soft and Auto Reset faults.) The CCB turns off the Powered Vent and the IRI Gas. The pump remains on for the selected post-circulate time to cycle the hot water out of the boiler. The FCB's are commanded to shut down and the Alarm output is turned on. The green LED turns off and the red "Service" turns on and off (flashes). The only way to exit this state is for the user to press the Select key while the current error screen is displayed. The fault is logged in the error history when the fault state is exited.

While the CCB is in the Heating mode the activated FCB stage moves from Idle, to Pre-Purge, to Heat Igniter, to Check for Flame, and then to Heating. The process waits in this state until the call for heat is satisfied, the thermostat input is opened, or a fault occurs. When heat is satisfied, the sequence continues to Post-Purge and then back to Idle. If three tries for ignition has been selected on the CCB dipswitch and flame is not detected at the appropriate time, then the sequence moves to the Inter-Purge state for 15 seconds and the FCB heat sequence is repeated. If flame is still not detected after the third try the process declares a fault, jumps out of sequence and goes to the error state. Other types of faults detected at any time will also cause a jump to the error state.

Description of FCB control states:

- Idle State:
  When any error is declared during idle state-The system will remain in this state until the CCB request a heating cycle, or a cold purge.
- Pre-Purge State:
  If the stage does not have a blower, this state is skipped and the system advances to the Heat Igniter State. Otherwise the Blower is turned on. After 10 to 34 seconds (34 seconds for cold purging) the system switches to the Heat Igniter State.
- Heat Igniter State:
  The sequence of operation is as follows: "The igniter relay is energized and the heat up period begins. After 18-20 seconds, if the igniter has reached a minimum of 2.8 amps, the gas valve safety circuit is then activated. If in this amount of time, the igniter fails to reach a minimum amp draw of 2.8 amps, the unit will re-cycle up to 3 times before locking out on igniter hardware failure. If the igniter does reach the minimum required amp draw of 2.8 amps, the gas valve circuit is energized, and the system advances to Flame Check status.

- Check for Flame State:
  The gas valve is turned on. After 1.5 seconds, the system checks that the gas valve relay is on. If it is not, the ignition trial is considered to have failed and the system advances to the Inter-Purge state, if any ignition trials remain, otherwise an error is declared.

  The flame sensor is checked. If flame is detected, the igniter is turned off. The state machine then advances to the Heating State. If after 5 seconds, the flame is still not sensed then the ignition trial is considered to have failed. The state machine advances to Inter-Purge if any ignition trials remain, otherwise an error is declared.

- Heating State:
  The system remains in this state until the call for heat is cancelled or a fault occurs. The system returns to the Idle state if the call for heat is cancelled, or satisfied and to the appropriate fault state if a fault occur.

- Inter-Purge State:
  The gas valve and the igniter are turned off. The blower is on. After approximately 15 seconds the system goes back to the Heating Igniter State.

- Post-Purge State
  The gas valve and the igniter are turned off. If this stage does not have a blower the system returns to the idle state. If it does have a blower then the blower is left on. After approximately 25 seconds, the system returns to the Idle state.

- Error State
  The gas valve and the igniter are turned off. The FCB micro tells the CCB micro which error has occurred. The system waits in this state until the CCB sends a command to clear the error, and the system returns to the idle state.

- Cold Purge State
  Cold purge occurs when the CCB micro commands all blowers to go on before lighting the first stage to clear the unit of residual gases. This state normally lasts approximately 32 seconds but on a special situation can last up to 5 minutes. If on the first call for heat after power up, blower prover switch is open, this state will take up to 5 minutes before declaring an error. This special mode is used by service technicians to adjust the blower shutter.

  The CCB will wait the normal cold purge time (normally 32 seconds) before checking for activation of all active blower prover. If blower prover is active at this time the CCB cancels the cold purge request. After the first cold purge has been done a flag is set to prevent further activation of the shutter adjust 5 min. delay. Any further requests for cold purge will last the normal cold purge time. The FCB will go into fault mode if the blower prover does not activate after 15 seconds. This time allows the blower relay to activate, the blower to come up to speed, and the response from the blower prover to be filtered.

- User Settings Screen:
  Each setpoint or user setting has either a limited selection of values, or a limited range of values. The Up/Down keys are used to change values. After changing an item, the Select key is pressed to accept the change, or the Menu key is pressed to reject the change and restore the item to its original value. The following setpoints can be changed:

- Operating Setpoint:
  This setpoint sets the base temperature for the control algorithm. See Figures 20A & 20B.

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OPERATING SETPOINT ADJUSTMENT PROCEDURE

The system has a standard programmable Operating Setpoint range of 70 Degrees F to 190 Degrees F for a GW and of 70 Degrees F to 220 Degrees F for a GB for either tank or inlet probe depending on selection. The user can easily change the Operating Setpoint at any time by using the following procedure. When any configuration or setpoint is changed (and the Select key touched), the new value is IMMEDIATELY saved to non-volatile memory. The factory default setting is 120 Degrees F.

1. Touch the MENU key.
2. Scroll the ">" with the DOWN key next to the USER SETTING SCREEN.
3. Touch the SELECT key.
4. Scroll the ">" with the DOWN key until it is pointing to OPERATING SETPOINT.
5. Touch the SELECT key.
6. Use the UP or DOWN key to select the value you wish to enter.
7. Touch the SELECT key to accept and store the new value.

- High Limit:
  The outlet temperature probe contains both an ECO switch and a thermistor for temperature measurement. The sensed outlet temperature is used for the automatically resettable High Limit setpoint. If the sensed outlet temperature exceeds the High Limit setpoint, a "soft lockout" condition will occur and the burner will be shut off. This fault condition is automatically cleared when the temperature drops below the high limit setpoint minus the high limit differential.

AUTO HIGH LIMIT SETPOINT ADJUSTMENT PROCEDURE/ OUTLET TEMP. PROBE

The High Limit setpoint has a range of 90 Degrees F to 210 Degrees F for a GW and a range of 90 Degrees to 235 Degrees F for a GB. Use the following procedure to change the automatically resettable High Limit Setpoint:

1. Touch the MENU key.
2. Scroll the ">" with the DOWN key next to USER SETTING SCREEN.
3. Touch the SELECT key.
4. Scroll the ">" with the DOWN key until it is pointing to HIGH LIMIT SETPOINT.
5. Touch the SELECT KEY.
6. Use the UP and DOWN key to select the value you wish to enter.
7. Touch the SELECT key to accept and store the new value.

- High Limit Differential:
  The outlet temperature must be below the automatic High Limit setpoint minus the High Limit Differential setpoint before a call for heat can be generated.

HIGH LIMIT DIFFERENTIAL SETPOINT ADJUSTMENT PROCEDURE

The High Limit Differential Setpoint has a range of 1 Degree F to 50 Degrees F for all models. Use the following procedure to change the High Limit Differential Setpoint:

1. Touch the MENU key.
2. Scroll the ">" with the down key next to USER SETTING SCREEN.
3. Touch the SELECT key.
4. Scroll the ">" with the DOWN key until it is pointing to HIGH LIMIT DIFFERENTIAL SETPOINT.
5. Touch the SELECT key.
6. Use the UP or DOWN key to select the value you wish to enter.
7. Touch the SELECT key to accept and store the new value.

- Operating Differential Setpoints:
  Each of the two stages has an independent Operating Differential setpoint.

OPERATING DIFFERENTIAL SETPOINT ADJUSTMENT PROCEDURE

Each of the two stages has an independent Operating Differential Setpoint. The range of these setpoints is from 1 Degree F to 50 Degrees F for all models. Use the following procedure to change this setpoint:

1. Touch the MENU key.
2. Scroll the ">" with the DOWN key next to USER SETTING SCREEN.
3. Touch the SELECT key.
4. Scroll the ">" with the DOWN key until it is pointing to OPERATING DIFFERENTIAL SETPOINT.
5. Touch the SELECT key.
6. Scroll the ">" with the DOWN key until it is pointing to the STAGE you want.
7. Touch the SELECT KEY.
8. Use the UP and DOWN key to select the value you wish to enter.
9. Touch the SELECT key to accept and store the new value.

- **Temperature Units:**
  Temperature can be displayed in either °F or °C units.
- **Post Circulate Delay Time:**
  The time circulation pump will stay on after the burner is turned off. The time in seconds is adjustable with the following values: 45, 90, 180 or continuous. If the continuous value is selected the pump will remain on at all times and the post circulate state time will be set at 45 seconds.
- **Network Address:**
  This is a unique number assigned to this boiler to differentiate it from other boilers or water heater on the same A. O. Smith proprietary network. A valid Network Address can be any number from 1 to 31. It is set by default to zero, which is an invalid address. The boiler will not communicate until it is changed to a valid and unique number. This prevents two units from trying to respond to the same request from the PC or supervisory network device.
- **Configuration Settings Screen:**
  Displays the status of the dipswitches installed on all boards as described earlier.
- **Log & System Info Screen:**
  Displays the following information:
  Elapsed hours of operation (Total time system has been powered up)
  Number of running minutes (Number of minutes system has been in the run mode)
  Number of cycles for each stage (Number of times stage has been in heat mode).
  kBtu rating of the boiler (0 to 5750kBtu in 10kBtu increments)
  The software revision level of the CCB, and FCB microcontrollers.

Current Error Screen:

- Displays the last error that the system has detected plus a time stamp of when the error occurred. (The time stamp is based on the elapsed hours value at the time the error occurred. It is displayed in hours and minutes. This error remain displayed as long as it is still valid. When cleared it is moved to the Error History Screen. The system will automatically jump to this screen

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when an error is detected. It will also go to this screen upon power-up if an error was still valid when power was turned off.

NOTE: Errors are cleared from this screen by pressing the "select" key.

- **Error History Screen:**
  This screen displays a list of the last 9 errors (with time stamps) that have occurred. The last error to occur is displayed first. If a new error occurs this screen is presented to display the error.
- **Reload Defaults Screen:**
  From this screen the user can restore the factory default values for screen adjustable configurations by pressing the Select key. The values restored are as follows:

  GW Models
  Oper Setpnt (Operating Setpoint) - 145° F (63° C)
  Stage1 Diff (Operating Setpoint Differential) = 3° F (2° C)
  Stage2 Diff (Operating Setpoint Differential) = 6° F (3° C)
  Hi Limit (High LImit Setpoint) = 210° F (99° C)
  Hi Limit Dif (High Limit Differential) = 20° F (11° C)

  GB Models
  Oper Setpnt (Operating Setpoint) = 190° F (88° C)
  Stage1 Diff (Operating Setpoint Differential) = 3° F (2° C)
  Stage2 Diff (Operating Setpoint Differential) = 6° F (3° C)
  Hi LImit (High LImit Setpoint) = 230° F (110° C)
  Hi Limit Dif (High Limit Differential) = 20° F (11° C)

  Both Models
  Tempert Units (Temperature Units) = F
  Post Cir Secs (Post Circulation pump delay = 45 seconds
  Network Address (Network Address) = (none)

UIM Touch Switches
Below the LCD display are five touch switches or keys, that the operator uses to operate the system.

- Menu Key:
  Pressing this key activates the menu screen where the other screens can be accessed.
- Select Key:
  This key performs several functions. Screens can be selected from the menu screen by pressing this key when the">" appears next to the screen desired.

  On the User Settings screen items that appear next to a ">" symbol can be selected with this key. If a setpoint configuration item is selected, the ">" will then flash slowly to indicate that the item has been selected. The Up and Down keys are then used to change its value.

  From the Current Error Screen this key is used to reset the system from an error:
- Up and Down Keys:
  These keys are used to move upwards and downwards in screens to reach a desired item and to change setpoints and user settings. They have an auto increment/decrement feature for some of the configurations and values. When you first press one of the keys and value changes by 1 count, then wait 1/2 second and changes slowly until the key is released or if held for 3 or more seconds it will change the value quickly.
- Help Key:
  Pressing the Help key from any screen displays helpful information about that screen. From the menu screen, general help information is displayed as to how to use the user interface. To return to the previous screen press the Help or Select keys, or press Menu key to go to the menu screen. If a small down arrow appears in the lower right hand corner then there is off screen content below what is displayed. Press the down arrow to scroll down to this information. After scrolling down an up arrow will appear in the upper right hand corner to indicate off screen content above what is displayed.

UIM LED's
The three LED's to the right of the LCD indicate the status of the overall system. The red LED indicates that a fault has been detected and the system has stopped running. It is on continuously for soft faults and flashes for hard faults. The Yellow LED indicates that the boiler is in a ready mode waiting for a call for heat command. When on continuously the Green LED indicates that the system is in the heating mode. If it is flashing it indicates that the UIM is in the initialization mode and the touch switches are being calibrated.

On these boilers there are also eight LED's on the lower right that indicate the state of the individual FCB's. The red LED's are only on when the main red LED is on and indicate which FCB has the error. The green LED indicates when flame is proved on that particular stage, unless the dipswitch for sensing flame is turned off. Then the LED indicates that the gas valve has turned on.

Fault Messages and Troubleshooting Guide
The EMC5000 system does excessive self-diagnostics and displays detected faults on the UIM display in an easy to read manner. There are approximately 80 different faults that can be detected. Some of the faults are caused by internal problems and some by external causes. The faults create different types of system lockouts (shut down). Hard lockouts are serious problems that require the user to manually restart system. Soft lockouts can be reset by the user or after 60 minutes the system will automatically clear the error and restart. Auto Reset lockouts will monitor the cause of the fault and if the fault clears itself the system reset itself. The fault is recorded and the system immediately resets itself. The following table shows the fault messages and some possible troubleshooting hints:

TROUBLESHOOTING IGNITION SYSTEM

Fault Messages and Lockout Status (* = stage number: 1, 2, 3, or 4)

FAULT DISPLAYED	DESCRIPTION	RED LED	LOCKOUT
"Display Fail"	**Communications with UIM interrupted**	**Continuous**	**Auto Reset**
	Check communication cable to UIM. Try moving to other Internal Communications connector on CCB. Also check the connectors where the cable is plugged in for best connecting wires.		
"Comm. Fail Stg.*"	**Communications with FCB interrupted**	**Continuous**	**Auto Reset**
	Same as above. Also try swapping FCB and UIM communications cables.		
"Low AC Voltage"	**Line voltage less than 90 vac**	**Continuous**	**Auto Reset**
	Check incoming power line for loss of voltage. May also be caused by a power line brown-out (momentary loss of voltage)		

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"Low 24VAC"	**Voltage from transformer less than 18 vac** Check transformer output. Should be over 24vac. May be caused by excessive current drain or a faulty transformer	**Continuous**	**Auto Reset**
"Brown Out Reset"	**Indicates a brown out reset occurred** Caused by a momentary dip in voltage on the CCB +5vdc power bus. Contact factory. (Not considered a serious problem if it only occurs on very rare occasions.)	**- - - -**	**None**
"Timeout Reset"	**Indicates a watchdog reset occurred** Caused when the micro executes the software in an improper way. Contact factory. (Not considered a serious problem if it only occurs on very rare occasions.)	**- - - -**	**None**
"FCB Comm Timeout"	**FCB did not receive command from CCB** Caused when communications between the CCB and the FCB are interrupted. May occur when a surge of power on a nearby device (i.e. arc welder) creates an EMI burst. Not a serious problem if it occurs rarely.	**Continuous**	**SOFT**
"No Flow"	**Water is not flowing** Caused by the flow switch being open when it should be closed. Check water lines, pump, flow switch contacts, wiring.	**Continuous**	**SOFT**
"Blower Prov Stg*	**Blower pressure is too low it they should have been closed.** Check blower, switch contact, wiring, and for air leaks.	**Continuous**	**SOFT**
"Blocked Flue"	**Flue is Blocked** Caused by the blocked flue switch contacts being open when they should have been closed. Check for flue blockage, switch contacts, wiring.	**Continuous**	**SOFT**
"High Limit"	**Outlet temp. exceeded high limit setpoint** Caused when the temperature of the outlet probe exceeds the high limit setpoint. This is an internal "software" limit switch and not an actual device. Check that the over temperature is not being caused by improper setup or operation of the boiler.	**Continuous**	**Auto Reset**
"ECO fault"	**Outlet temp is too high** Caused when the ECO (a thermostat) contacts in the Outlet probe are open when they should be closed. Fault may be due to high outlet temperature, bad switch contacts in the ECO, or disconnected wiring. Note: The ECO can be checked by disconnecting the outlet probe from the CCB and reading the resistance across the two active pins on the connector at the end of the probe cable. The value should be approximately 0 ohms when the temperature of the probe is less than 220°F.	**Flashing**	**HARD**
"Low Water"	**Water level is too low** Caused by the Low Water Cut Out device not closing its feedback switch contacts when it should. Check water line, switch contacts, wiring, LWCO.	**Flashing**	**HARD**
"Low Gas"	**Gas pressure is too low** Caused by the Low Gas switch being open when it should be closed. Check gas line, switch contacts, wiring.	**Flashing**	**HARD**
"IRI Gas"	**IRI Gas Valve did not turn on** Caused by the IRI Gas Valve not closing its feedback switch contacts when it should. Could also be caused by a problem with the relay output on the CCB. Check output to IRI Gas Valve, switch contacts, wiring.	**Flashing**	**HARD**
"Powered Vent"	**Power vent not running** Caused by the Powered Vent device not closing its feedback switch contacts when it should. Could also be caused by a problem with the relay output on the CCB. Check output to powered vent, switch contacts, wiring.	**Flashing**	**HARD**
"High Gas Stg*"	**Gas pressure too high** Caused by the High Gas switch being open when it should be closed. Check gas line, switch contacts, wiring.	**Flashing**	**HARD**
"Inlet Probe"	**Inlet probe shorted or open** Caused when the thermistor in the probe or the wiring to the probe is shorted or disconnected. Check the probe. Note: The thermistor and wiring can be checked by disconnecting the probe from the CCB and reading the resistance across the two active pins on the connector at the end of the probe cable. The value should be approximately 10K ohms (value will change slightly with changes in temperature).	**Flashing**	**HARD**
"Outlet Probe:"	**Outlet probe shorted or open** Caused when the thermistor in the probe or the wiring is shorted or disconnected. Check the probe. Note: the thermistor and wiring can be checked by disconnecting the probe from the CCB and reading the resistance across the two active pins on the connector at the end of the probe cable. The value should be approximately 10K ohms (value will change slightly with changes in temperature).	**Flashing**	**HARD**

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"Tank Probe"	**Tank (Remote) probe shorted or open**	**Flashing**	**HARD**

Caused when the thermistor in the probe or the wiring is shorted or disconnected. Check the probe. Note: the thermistor and wiring can be checked by disconnecting the probe from the CCB and reading the resistance across the two active pins on the connector at the end of the probe cable. The value should be approximately 10K ohms (value will change slightly with changes in temperature).

"Igniter Stg*"	**Igniter current is too low**	**Flashing**	**HARD**

Caused by a low current draw problem with the igniter. This may occur if the igniter is old, damaged, or disconnected and no longer draws the proper level of current. This condition will affect the ability of the igniter to get hot enough to fire the gas properly. Check the igniter and its associated wiring.

"Igniter Pwr Stg*"	**Improper power applied to the igniter circuit**	**Flashing**	**HARD**

Caused by improper line power being applied to the igniter circuitry. Check line connections. Paying particular attention to the earth ground connection. Also check that line voltage does not exceed 132 vac rms.

"Igniter Hdwr Stg*"	**Hardware problems with igniter circuit**	**Flashing**	**HARD**

PREVENTATIVE MAINTENANCE

This is an induced burner and the flame is not supposed to be directly on the burner. The flame should be just above the burner deck approximately 1/8" and blue in color. See Figure 22.

Visually check flame characteristics through the view port located under the left-hand header on the boiler. Figure 22 shows the normal flame condition. Also, refer to the flame label on the unit (adjacent to the view port).

These boilers are designed to give many years of efficient and satisfactory service when properly operated and maintained. To assure continued good performance, the following recommendations are made.

The area around the unit should be kept clean and free from lint and debris. Sweeping the floor around the boiler should be done carefully. This will reduce the dust and dirt which may enter the burner and heat exchanger, causing improper combustion and sooting.

MAIN BURNERS

Check main burners every three months for proper flame characteristics. The main burner should display the following characteristics:

- Provide complete combustion of gas.
- Cause rapid ignition and carry over of flame across entire burner.
- Give reasonably quiet operation during initial ignition, operation and extinction.
- Cause no excessive lifting of flame from burner ports. See Figure 22.

If the preceding burner characteristics are not evident, check for accumulation of lint or other foreign material that restricts or blocks the air openings to the burner or boiler. To check burners:

1. Shut off all gas and electricity to unit. Allow unit to cool.
2. Remove main burners from unit.
3. Check that burner venturi and ports are free of foreign matter.
4. Clean burners with bristle brush and/or vacuum cleaner. DO NOT distort burner ports.
5. Reinstall burners in unit. Ensure that all the screws on the burner flange are tightened securely so that the gasket will provide a good seal. Also, ensure that each orifice is centered with the venturi opening of every burner. **The washer of the orifice must be inserted a minimum of 1/4" into the burner tube. This is critical for proper operation. See Figure 23.**
6. Also check for good flow of combustion and ventilating air to the unit.

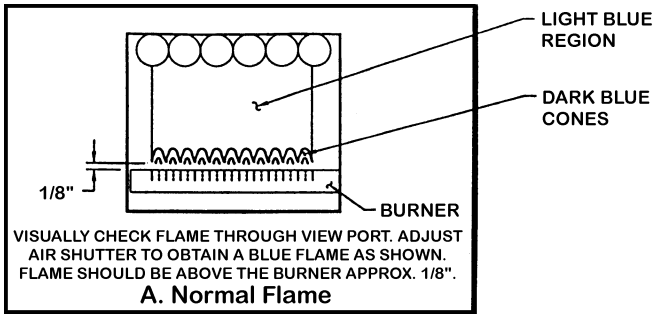
LIGHT BLUE REGION
DARK BLUE CONES
1/8"
BURNER
VISUALLY CHECK FLAME THROUGH VIEW PORT. ADJUST AIR SHUTTER TO OBTAIN A BLUE FLAME AS SHOWN. FLAME SHOULD BE ABOVE THE BURNER APPROX. 1/8".
A. Normal Flame

Figure 22. Normal Flame Characteristics

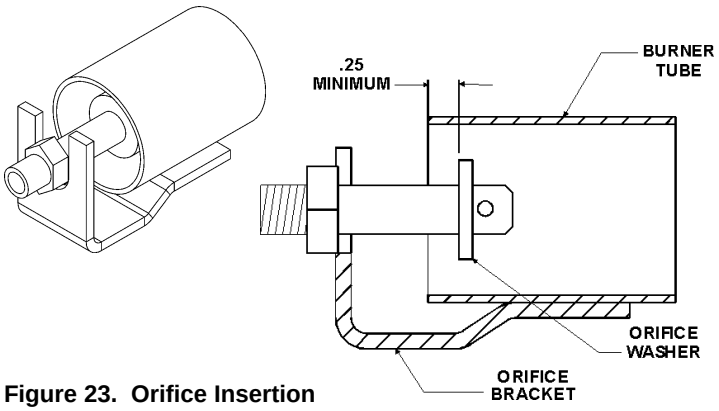

Figure 23. Orifice Insertion

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After placing the boiler in operation, check the ignition system safety shut-off devices for proper operation. To accomplish this with the main burners operating, close the valve on the manifold. Within four seconds the main burners should extinguish. If this does not occur immediately, discontinue gas supply by closing main manual shut-off and call a qualified serviceman to correct the situation. If the burners extinguish, then light boiler in accordance with lighting and operating instructions.

For installations above 4,500 feet (1350 m), refer to HIGH ALTITUDE INSTALLATIONS in the installation section. See page 5.

THE FLOW OF COMBUSTION AIR TO THE BOILER MUST NOT BE OBSTRUCTED.

THE BOILER AREA MUST BE KEPT CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. Periodic checks, at least twice a year, should be made for water and/or gas leaks.

More frequent inspections may be necessary depending on water conditions.

The boiler-mounted gas and electrical controls have been designed to give both dependable service and long life. However, malfunction can occur, as with any piece of equipment. It is therefore recommended that all components be checked periodically by a qualified serviceman for proper operation.

RELIEF VALVE

The safety relief valve should be opened at least twice a year to check its working condition. This will aid in assuring proper pressure relief protection. Lift the lever at the top of the valve several times until the valve seats properly and operates freely.

⚠ DANGER

THE WATER PASSING OUT OF THE VALVE DURING CHECKING OPERATION MAY BE EXTREMELY HOT. BEFORE OPERATING RELIEF VALVE, MAKE SURE DRAIN LINE IS INSTALLED TO DIRECT DISCHARGE TO A SAFE LOCATION SUCH AS AN OPEN DRAIN, TO AVOID SCALDING OR WATER DAMAGE.

⚠ WARNING

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN OFF THE MANUAL GAS CONTROL VALVE TO THE APPLIANCE.

COMBUSTION AIR FILTER

If the combustion air supply to the boiler contains dust, dirt, drywall dust etc. a filter must be installed. An air filter is not supplied with the boiler as shipped from the factory. The installer must provide a filtering system in the air inlet to the boiler if dust, dirt or construction dirt can be pulled into the boiler through the inlet air piping. Periodically clean air filter per the manufacturer's instructions.

BLOWER COMPARTMENT

The blower compartment should be cleaned annually to remove any dirt and lint that may have accumulated in the compartment or on the blower and motor. Buildups of dirt and lint on the blower and motor can create excessive loads on the motor resulting in higher that normal operating temperatures and possible shortened service life.

VENTING MAINTENANCE

It is recommended that the intake and exhaust piping of the appliance be checked every 6 months for dust, condensate leakage, deterioration and carbon deposits.

⚠ WARNING

DO NOT USE A NYLON BRUSH OR OTHER STATIC CREATING MATERIAL TO CLEAN DUST AND CARBON DEPOSITS FROM HEATING SURFACES AND VENT. SUCH DEPOSITS ARE FLAMMABLE AND MAY BE IGNITED BY STATIC ELECTRICITY. USE A METAL BRUSH TO MINIMIZE THE DANGER OF EXPLOSION.

Qualified serviceman should follow this procedure when the boiler's intake and exhaust piping need cleaning:

1. Turn off the electrical power, and manual gas shut-off.
   - Allow boiler parts to cool before disassembly.
2. Remove the vent pipe.
   - Check parts and chimney for obstructions and clean as necessary.
3. Remove burners from boiler and other metal parts as required to clean as necessary.
   - Refer to parts list for disassembly aid.
4. Clean and reinstall the parts removed in steps 2 and 3.
   - Be sure the vent pipe has a minimum upward pitch of 1/4" per foot (2 cm/m) of length and is sealed as necessary.
5. Restore electrical power and gas supply to boiler.
   - Check for gas leaks and proper boiler and vent operation.

HEAT EXCHANGER PREVENTIVE MAINTENANCE

In most water supply systems solids exist. As the water is heated, these tend to drop out depositing as scale or lime. This scale must be removed before the heat exchanger tubes become blocked.

⚠ CAUTION

LIME ACCUMULATION CAN REDUCE THE LIFE OF THE EQUIPMENT, REDUCE EFFICIENCY AND WASTE FUEL. BOILER FAILURE DUE TO LIME OR SCALE BUILDUP VOIDS THE WARRANTY.

DELIMING

The amount of calcium carbonate (lime) released from water is in direct proportion to water temperature and usage. The higher the water temperature or water usage, the more lime deposits are dropped out of the water. This is the lime scale which forms in pipes, boilers and on cooking utensils.

The usage of water softening equipment greatly reduces the hardness of water. However, this equipment does not always remove

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all of the hardness (lime). For this reason it is recommended that a regular schedule for deliming be maintained.

The time between cleaning will vary from two to six months depending upon water conditions and usage. A change of approximately 5°F (3°C) in the normal temperature rise through the boiler is usually an indication that scale should be removed. For long life, copper or brass is recommended for all valves, pipe and fittings.

TUBE CLEANING PROCEDURE
MECHANICAL REMOVAL OF DEPOSITS

Establish a regular inspection schedule, the frequency depends on the local water conditions and severity of service. Do not let the tubes clog up solidly. Clean out deposits over 1/16" (1.6 mm) thickness.

To service heat exchanger tubes, remove return header casting on the side opposite the water connections. Use a U.S. standard 5/8" deep socket ratchet to remove the nuts, exposing the tube ends. Inspect to ensure tubes are free of scale and deposits. If scaled, remove deposits with a stiff wire brush or mechanical tube cleaner to bare metal. Reinstall return header casting. Flush system.

Note: Removal of the heat exchanger is not required.

⚠ CAUTION

IF HEAT EXCHANGER MAINTENANCE REQUIRES TUBING REPLACEMENT, SPECIAL PROVISIONS SHALL BE TAKEN TO ENSURE THAT THE DAMAGED TUBES ARE CAREFULLY REMOVED.

REPLACEMENT TUBES MUST BE PROPERLY INSTALLED AND EXPANDED INTO THE ROLLED TUBE TUB.

OVER-ROLLING, MISALIGNMENT OF TUBES OR IMPROPER TIGHTENING OF THE ASSEMBLY MAY RESULT IN LEAKS OR DAMAGE TO THE HEAT EXCHANGER. CONTACT YOUR A. O. SMITH DEALER FOR DETAILED INSTRUCTIONS.

REPLACEMENT PARTS

Replacement parts may be ordered through A. O. Smith dealers, authorized servicers or distributors. Refer to the Yellow Pages for where to call or contact (in United States) the **A. O. Smith Water Products Company, 500 Tennessee Waltz Parkway, Ashland City, TN 37015, 1-800-433-2545 or (in Canada) A. O. Smith Enterprises Ltd., 768 Erie Street, Stratford, Ontario, Canada N5A 6T3, 519-271-5800.** When ordering parts be sure to state the quantity, part number and description of the item including the complete model and serial number as it appears on the product. Refer to the parts lists (P/N 212513-000) for more information.

For Technical Assistance call A. O. Smith Technical Information Center at 1-800-527-1953.

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NEW BOILER LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this hydronic boiler:

1. If within TEN years after initial installation of the boiler, the heat exchanger shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option, will exchange or repair such part or portion. This term is reduced to FIVE years if this boiler is used for volume hot water supply purposes other than hydronic space heating.
   a. This warranty is extended to the owner for all other parts or portion during the FIRST year following initial installation of this boiler.
   b. The warranty on the repair or replacement of the part or portion will be limited to the unexpired term of the original warranty.

2. **CONDITIONS AND EXCEPTIONS**
   This warranty shall apply only when the boiler is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, an appropriately sized safety relief valve certified to the ASME Boiler and Pressure Vessel Code must have been installed and fresh water used for filling and makeup purposes;
   a. This warranty shall apply only when the boiler is used:
      (1) at temperatures not exceeding the maximum setting of its operative and/or high limit control;
      (2) at water pressure not exceeding the working pressure shown on the boiler;
      (3) when filled with boiler water, free to circulate at all times and with the heat exchanger free of damaging scale deposits;
      (4) in a noncorrosive and non-contaminated atmosphere;
      (5) in the United States, its territories or possessions, and Canada;
      (6) at a water velocity flow rate, not exceeding or below the Boiler's designed flow rates;
      (7) in properly sized piping system in accordance with A.O. Smith WPC sizing guidelines.

   b. Any accident to the boiler, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form will void this warranty.

3. **SERVICE AND REPAIR EXPENSE**
   Under this limited warranty the warrantor will provide only a replacement part. The owner is responsible for all other costs. Such costs may include but are not limited to:
   a. Labor charges for service removal, repair or reinstallation of the component part;
   b. Shipping, delivery, handling, and administrative charges for forwarding the replacement part from the nearest distributor and returning the claimed defective part to such distributor;
   c. All cost necessary or incidental for any material and/or permits required for installation of the replacement.

4. **LIMITATIONS ON IMPLIED WARRANTIES**
   Implied warranties, including any warranty of merchantability imposed on the sale of this boiler under state law are limited to one (1) year duration for the boiler or any of its parts. Some states or provinces do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

5. **CLAIM PROCEDURE**
   Any claim under the warranty should be initiated with the dealer who sold the boiler, or with any other dealer handling the warrantor's products. If this is not practical, the owner should contact:

U.S. Customers	Canadian Customers
A. O. Smith Water Products Company	A. O. Smith Enterprises Ltd.
500 Tennessee Waltz Parkway	P. O. Box, 310 - 768 Erie Street
Ashland City, TN 37015	Stratford, Ontario N5A 6T3
Telephone: 800-323-2636	Telephone: 800-265-8520

   a. The warrantor will only honor replacement with identical or similar parts thereof which are manufactured or distributed by the warrantor.
   b. Dealer replacements are made subject to in-warranty validation by warrantor.

6. **DISCLAIMERS**
   NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE ON BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE BOILER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE BOILER. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR TORT.
   a. Some states or provinces do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitations or exclusions may not apply to you.
   b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the boiler's rating plate.

Owner_____

Installation Address_____

City and State or Province_____ Postal/Zip Code_____

Date Installed_____ Model No._____ Serial No._____

Dealer's Name_____

Dealer's Address_____ Phone No. _____

FILL IN WARRANTY AND KEEP FOR FUTURE REFERENCE

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A.O.Smith
Water Heaters

500 Tennessee Waltz Parkway, Ashland City, TN 37015
Phone: 800-433-2545
www.hotwater.com E-Mail: parts@hotwater.com

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